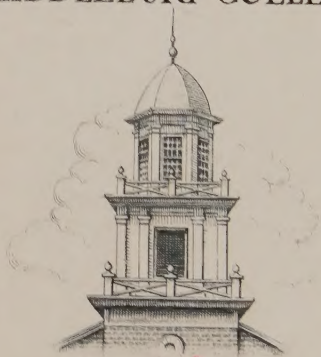
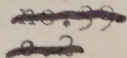


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GUIDE
TO THE
INSECTS OF CONNECTICUT

PART V

The Odonata or Dragonflies
of Connecticut

By

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- Check List of the Insects of Connecticut. By W. E. Britton.
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Odonata or Dragonflies of Connecticut

PHILIP GARMAN

INTRODUCTION

Dragonflies or Odonata form a branch of Insecta frequently encountered and often considered in biological work. They have been much studied by naturalists, perhaps as completely as any other order of insects, and the present work does not purport to establish anything especially new or original. Its main purpose is to bring together as much information about dragonflies in Connecticut as is possible (within reasonable limits) at the present stage of our knowledge, and to present it in usable form; and as every science is built upon knowledge acquired by previous workers, so the present work has been founded upon the work of such men as Baron de Selys, Ris, Tillyard, Needham, Calvert, Walker, Williamson, and Howe.

Dragonflies are among the most beautifully colored and delicately constructed of all insects. They deserve consideration by the amateur naturalist, as well as the professional. Moreover, they are desirable tenants in mosquito-plagued districts and, if they could only be reared in large numbers, would form a natural arm of defense against a universal nuisance. Few insects combine such a useful career with the natural beauty that we find in dragonflies, and so it is hoped that the present small contribution will help some one at least to know the dragonfly better and to appreciate its many admirable qualities.

PART I: BIOLOGY AND MORPHOLOGY, COLLECTION AND ILLUSTRATION

HABITS AND LIFE HISTORY

All except a few dragonflies are aquatic when young. They feed mostly upon mosquitoes, small flies and other insects, and are beneficial. Cases have been reported where the nymphs fed upon small fish, and still others in which trees were injured by oviposition, but such instances are rare, and the amount of destruction occasioned is negligible. Some work (Wilson, 1917-18), in fact, indicates that the nymphs of Odonata probably never attack fish in their native haunts.

As far as known there is never more than one brood of dragonflies per season in Connecticut, while the larger Aeshnids probably

require three or four years to develop. Zygoptera or damselflies begin to emerge early in spring (April), and some species continue to emerge until fall (September). Some of the larger Anisoptera are more frequently seen in July, August and September, their emergence taking place during late summer. Cordulines and Gomphines are most abundant in June.

Most damselfly nymphs may be taken among vegetation of one sort or another, but a few occur under rocks or rotten logs in swift currents. The Anisoptera may be found mostly in the mud at the bottom of the stream or lake, where they conceal themselves by attaching rubbish to their bodies, or by burrowing in the mud itself. Some, of course, inhabit floating vegetation.

Odonata are fond of unpolluted water and do not thrive where there is much contamination. Ponds and lakes about which cows or horses are allowed to graze are frequently without dragonflies, or with only a few of the more hardy species. The gradual pollution of fresh water in the New England States and elsewhere has, moreover, reduced the relative numbers of dragonflies so that one should collect in many localities to obtain a complete collection of these interesting creatures. Fortunately many lakes have become public property and included in parks and estates, while still others have become reservoirs for the supply of towns, cities and villages, and the sources of contamination removed or abated. For this reason the dragonfly's prospects for the future are better, though evidently they are not as numerous as a half-century ago.

Many families of dragonflies select their environment, and some species may nearly always be found under certain ecological conditions. For instance, the nymphs of the Agrionidae, among which the black-wings are perhaps the most common examples, are found in clear woodland or meadow brooks. The nymphs of Argias are most frequently found in running or moving water under stones, logs, etc., and the Lestinae, most frequently in bogs or fresh water ponds with considerable vegetation. Among the Anisoptera selection of environment is not as evident, but we find many Gomphidae in shallow, slow-flowing streams; a species of Libellulid (*Erythrodiplex berenice*) confined to brackish water along the sea coast; Sympetrum species frequenting bogs and marshes, and so on. Adults of certain species may be found fairly close to their nymphal environment, but some wander long distances from their former aquatic home. Aeshna species may be seen frequently a mile or so from the nearest water, and it seems likely that they fly many times this distance away from their natural haunts. Other species are known to congregate in sunny spots away from the water on the approach of cold weather. Still others prefer pasture lands as a hunting ground or the clear expanse of a lake or pond. The congregation of species may perhaps be connected with the migration of such as *Anax junius*,

Libellula pulchella, and *Libellula semifasciata*, which takes place northwards in spring and southwards in fall. Mr. C. R. Ely reports that he has witnessed the migration of dragonflies several times at his summer home in East River, Conn., the migrating insects being collected in a dense swarm, and moving along the sea coast.

Howe (1921, p. 132) came to the general conclusion that the distribution of a species should be stated "in both geographical and ecological terms," and that a species "may inhabit one or more, often three zones, and even two regions as defined by Merriam." It is thus important in determining distribution to note what is the nature of its environment if progress is to be made in our knowledge of the limits of its distribution. At present little is known concerning the factors governing a given species' range, but there are doubtless ecological conditions which control this phase of activity the same as for plants or other animals. In other words, distribution is a function of temperature, moisture, sunlight and other conditions, which depend in turn on altitude, latitude and the like. Food of the nymphs, conditions of the water as regards contamination, the amount of movement in the water, air temperature, and many other factors determine whether a species will be found in a given locality. To attempt to determine whether the necessary ecological conditions exist in Connecticut for each species is obviously impossible, but to compensate for our lack of knowledge along this line, many species have been included which have been captured in neighboring states. The chances that species not included in this article will be found in the state is thereby lessened considerably, though of course importations from long distances may occur.

Emergence from the water usually takes place late in the afternoon or evening, or early in the morning, though a great deal depends on the location. Damsel flies emerge throughout the day, and require only a few hours to develop enough to fly. The Anisoptera require longer, but even they are ready to begin the hunt again in an incredibly short time. Many species, however, do not obtain their full coloration until some days afterwards, and individuals thus immature are known as *teneral*.

The food of adult Odonata consists of small insects such as mosquitoes, gnats, beetles and moths. The larger Aeshnids are particularly active feeders and may be seen to capture insects of considerable size. Some species have been known to feed successfully on honey bees.

The nymphs of all species eat other insects, mainly the larvae of small Diptera, but the younger nymphs subsist on protozoa and crustacea, such as Clodocera and Copepoda. Probably others of the smaller groups are also eaten. We thus find the damsel fly feeding upon mosquito wrigglers in the later nymphal stages and

hunting down the mosquito itself when adult. No nymph, however, is fastidious in selecting its food, and there is hardly one which will not devour with apparent relish the members of its own family. Probably some of all aquatic families of insects are eaten as well as other aquatic animals not belonging to this class.

Nearly all damsel flies lay their eggs in the stems of plants. Of the Anisoptera, the Aeshnidae lay eggs in plants or soft mud, and the Cordulinae lay gelatinous masses containing many eggs which are draped over aquatic vegetation or other support.¹ The remaining families for the most part drop their eggs into the water direct.

The damsel flies often descend several inches below the surface of the water, but *Lestes* are said to oviposit above the surface. Libellulidae may frequently be seen skimming close to the water and occasionally dipping the tip of the abdomen, thereby releasing the egg, which sinks to the bottom.

The following interesting account of the oviposition habits of *Enallagma aspersum* is taken from an article in the *Maine Naturalist* II, p. 133, by William Colcord Woods: "After a sufficient trial of our patience, we saw a couple 'land' on a pipewort stem near by. They alighted head upward. The male released the female from his grasp, clung to the stem some ten or fifteen minutes, and then flew off to join his companions in their patrol, but his mate, rapidly executing an about face and folding her wings closely about her, hurried fearlessly down the stalk into the water. She crawled down the stem, and then explored the weed-grown bottom, poking her abdomen here and there, doubtless in the act of oviposition. From time to time she thrust her abdomen between her wings, which had a glistening silvery appearance under water, and we wondered whether she may have used air imprisoned there for respiration, for this species can remain under water a remarkably long time for an aerial species. She had ranged at least two feet from the stem on which she made her descent, and had been submerged more than twenty-five minutes when we disturbed her. Would she just stay down there and die? What would be the outcome of her plunge? It was not our patience but our noon-time which was exhausted, for we had not been sent down there to study blue damsel flies, so reluctantly one of us thrust in a stick and poked the busy mother. Immediately she loosed her hold, and floated at once to the surface, when to our utter astonishment down swooped a watchful male, who, catching her by the nape of the neck, drew her out of the water. As soon as she had been lifted above the surface film, she was able to use her wings, and the pair flew off together."

¹ Ent. News 16: 255-7: 1905.

PARASITES AND ENEMIES

The dragonfly, although itself predaceous, has enemies. Chief among these are fishes and birds. Fishes are particularly fond of the nymphs, which are reported to form 25 per cent of the food of a bullhead (Baker 1916); 25 per cent of the food of the grass pickerel (*Esox vermiculatus*); and about 13 per cent of the food of crappies (*Pomoxis annularis* and *P. sparoides*), and pirate perch (*Aphredoderus sayanus* Forbes 1888). The size of the fish, however, is important in determining the amount of Odonate food eaten. Wilson (1917-18, p. 229) claims that very small fish do not eat Odonata nymphs at all but that they are very fond of the eggs. Fish under 9 mm. in length eat no nymphs whatsoever, while fish such as the large-mouth bass, blue-gill, common sun fish, and calico bass, reach 22-25 mm. (about 1 inch) before they begin. Fish 75-105 mm. (3-4 inch) were found by Wilson to feed almost entirely on dragonfly nymphs, under some conditions.

Dragonfly nymphs are reported to be in demand as fish bait in several localities. Wilson (1917-18, p. 225) says that small boys in the vicinity of Torrington, Conn., collect and sell them as "perch bait," and in other localities they are used as bait for trout, rock-bass and perch. He also reports that adult damsel flies are more frequently eaten by fish than is supposed, and that fishes will snap up quickly any damsel fly that has been injured and is unable to rise from the water.

Birds are next in importance as enemies of Odonata, and their greatest success lies in capturing tenerals. English sparrows, robins, red-winged and yellow-headed blackbirds, shrikes, cuckoos, king birds, fly-catchers, and herons have been observed by various authors to eat Odonata. Herons feed upon the nymphs, the remainder upon adults. Shrikes, cuckoos, and king birds, especially the last, are said to be quick enough to capture fully mature adults. Walker, in fact, reports (1912; p. 36) that the appendages of *Epiaeschna heros*, one of the largest and swiftest dragonflies, have been taken from the stomach of the chuck-will's widow.

Turtles, terrapins and frogs (bullfrogs and cricket frogs) are enemies of Odonata. Bullfrogs are reported to feed upon nymphs and adults, and the cricket frog upon the adults of damsel flies.

The larger species of Odonata destroy the smaller and are therefore enemies. Aquatic Hemiptera and Coleoptera are vigorous insect feeders and will feed on Odonate nymphs when they encounter them. *Dytiscus*, *Zaitha*, *Ranatra*, *Belostoma*, and *Notonecta* have been reported in this connection, while ants and robber flies (*Asilidae*) are sometimes able to capture and overpower adults. Several egg parasites have been observed (Hymenoptera and Diptera), and the eggs of the damsel fly family *Lestinae*

are especially liable to attack, being exposed above the water line (Needham 1903).

Spiders are confirmed enemies of most insects and have been found to capture dragonflies.

Several species of water mites (*Hydrachnidae*) are often found clinging to nymphs and adults, especially damsel flies. They attach themselves to the nymph while young, crawl from nymph to adult at emergence, and gain the water again at oviposition. Little or no real harm is experienced by the dragonfly, and the mites seem to hang on mainly for the ride, obtaining, of course, free transportation from pond to pond. Only one case has been reported (Wilson 1917-18, p. 225) in which these mites were harmful to the host. However, adults have been observed by the writer so heavily laden with mites that they were unable to rise from the water. A red mite is also said to destroy the eggs of Odonata (Lamborn 1890, p. 50).

The fresh water hydra (*H. fusca*) was found by Wilson to devour recently hatched nymphs (Wilson 1917-18, p. 210).

Nematodes (gregarines) are known to inhabit the alimentary canal of dragonflies, but probably do little harm.

Several species of fungi and algae may be found growing upon the nymphs, but usually do little harm. The saprolegnias are sometimes injurious and even fatal, especially to crippled or feeble nymphs.

A filaria and a frog-lung fluke have been found in nymphs, but have not been reported from America. Likewise the giant sundew of Australia (Tillyard 1917, p. 329) is said to capture many damsel flies, but our American sundews are certainly not capable of duplicating this performance because of their small size.

GENERAL CHARACTERS OF THE ODONATA

The Odonata include insects, the adults of which have biting mouth parts and net-veined wings. The legs are weak and used mainly for support when at rest, though sometimes for grasping and holding prey.

All species have an incomplete metamorphosis, the aquatic nymph developing by successive stages until the last instar, when the insect leaves the water and the adult emerges. The transformation in changing from nymph to adult is almost as great as we find in orders with complete metamorphosis, but there is no true pupal stage and they are known as hemimetabolous (Comstock, 1920, p. 178).

Comstock has proposed the term *naiad* for the aquatic stages of Odonata, a term which has advantages. For example, the change from aquatic to aerial life necessitates much greater changes

in form than occur in many orders, and the term *naiad* would be limited to the young of Plecoptera, Ephemera and Odonata. Since the term has not been generally adopted, however, the word *nymph* is used here to designate the young of Odonata.

Odonata, Plecoptera (stoneflies) and Neuroptera (ant lions and dobson flies) are more closely related to one another than to other orders of insects; but although similar in many points, are readily distinguished in nymphal and adult stages. The basis of separation of adult Odonata from the Neuroptera and also the Ephemera lies in the presence of the nodus in the wing of all representatives of the dragonfly group. The nymphs are easily distinguished from others of similar form and habits by the possession of a hinged labium which folds beneath the head and is capable of being extended beyond the tip of the latter. The Neuroptera have no vestigial wings in the earlier stages, differing in this point from the Odonata.

Geologically, the dragonflies are one of the oldest orders, dating back to the Carboniferous period when related forms occurred with a wing-spread of more than two feet. Gradations between the Neuroptera and Odonata appear in these early periods and show with more or less certainty that the ancestors of the order were closely related to the Neuroptera of today.

Among Odonata, the more generalized or simpler condition as regards structure seems to be found in the Zygoptera. This theory has been questioned by Needham, who holds that Anisoptera are really simpler because of their wing venation. Taken as a whole, however, it seems probable that the Zygoptera have retained a simpler structure in most features. Moreover, the recent discovery of true Zygoptera in the Kansas Permian leaves no choice but to accept the former interpretation.

Scientists have recognized 2,400 or more species of dragonflies throughout the world (Tillyard 1917, p. 300). Muttkowski in 1910 listed 494 species from North America, and of these, some 160 occur in New England. Many of them have a wide range and may be expected to be found almost anywhere in the United States.

Compared with Coleoptera or beetles, for instance, dragonflies are few in numbers. A recent publication has described 1,084 species of weevils from the northeastern United States, and one author states that nearly 4,000 species of beetles probably exist in the State of Indiana. Our *Check List of Connecticut Insects* records 1,452 species of Lepidoptera (moths and butterflies) within the State and only 101 Odonata or dragonflies—showing the relative scarcity of dragonflies as compared with other insects. The number of species of dragonflies captured in Connecticut to date totals 112 and leaves about 50 of these herein described yet to be found.

The descriptions of nearly all species listed in subsequent pages have been made directly from the specimens themselves and were compared with descriptions by other workers, including the original in many cases. Descriptions of the rarer species have in some instances been compiled from the work of other authors. Every effort has been made to bring the systematic part up to date and to make it accurate and reliable. It is to be kept in mind, however, that variation among the dragonflies is considerable, and it is often impossible to state exactly the limits of these variations in terms that the reader will easily grasp. Generic descriptions have been made rather full, and care taken within large families to include the same characters in each for the sake of comparison. They form a summary of the matter contained in the keys rather than a reference to the latter.

Attention is called to a character of some taxonomic value in the separation of the Cordulinae and Libellulinae. This is the amount of curvature in the mesopleural suture. In all specimens examined, the corduline type shows this suture to be practically straight from the wing base to the katepisternum (infraepisternum) whereas in all Libellulinae examined, there is a decided upward bend just before reaching the katepisternum (Fig. 40).

The Catalogue of Muttkowski has been mainly followed as to nomenclature of species and families but is modified in a few instances on account of work done since the publication of that list. As regards systematic tangles, the Odonata are comparatively free, which is for the most part due to the excellent work of Calvert, Walker and Williamson, and to the earlier work of the Belgian, Baron de Selys. It is to be hoped that future workers follow the lead of these scientists. For the sake of convenience, the Anisoptera have been divided into five families instead of two as commonly used. This arrangement may be criticised but has some precedent in the publication of Hart and Needham (1901) and in the statement of Tillyard (1917, p. 258). This also seems to be a more natural grouping, since the families show nearly equal differentiation in structure. In point of numbers, on the other hand, the families are very unequal, but this is held to be no serious obstacle to their adoption as families.

THE EXTERNAL ANATOMY OF THE DRAGONFLY

The parts of the skeleton of any insect are similar, even in widely separated groups; but through the process of evolution many parts have been lost or so modified that they are only to be recognized by means of "landmarks" in the structure of the body wall. Moreover, the features used in classification are often so different in different orders that specialists do not agree as to the

FIG. 1. Adult Zygoteron (*Lestes vigilax*) showing parts. Epimeron of this figure is the same as epimerum of Fig. 2.

proper nomenclature. It is therefore important to note the "landmarks" for the recognition of the parts of the skeleton as well as to provide a means—with figures and general descriptions—for the guidance of the beginner; so that there may be no loss of time interpreting the English of a description, or confusion because of a knowledge of similar parts in other insects. To aid in understanding descriptions, a glossary of terms is appended (p. 300). In all descriptions the insect is regarded as in a natural position with feet on the ground and body parallel to the surface.

The body of all Odonata is divided into three main divisions, known as head, thorax, and abdomen. Each division is in turn composed of a number of rings or segments, more or less modified, but homologous with the segments of its wormlike ancestors. The external skeleton is provided with pigment and divided into sclerites or plates that are similar in different families and sub-orders. The lines separating the sclerites are called sutures.

THE BODY STRUCTURE

Adult

Head.—Surrounding the mouth opening are projections of the body wall and appendages designed to aid in capturing other insects and preparing them for its use. Just above the opening is found a broad, emarginate piece known as the labrum, which is about twice as broad as long. Above it is a fixed sclerite known as the clypeus (Fig. 3, a).

Above the clypeus and between the large compound eyes occupying the sides of the head is an area known as the front. It bears the jointed appendages called antennae. The front extends to the small ocelli or simple eyes and is usually bounded by a suture on each side below the compound eyes. The epicranial suture extends from the rear of the head to a joint just behind the ocelli where it forks and extends laterad to the compound eyes. The posterior surface of the head, on either side of the foramen or body opening, is commonly known as the occiput, and contains three sclerites, the occiput and two postgenae more or less fused.

Below the mouth opening there is a hinged organ, the labium, which in most individuals covers the entire lower surface of the head. Beneath the labium (or above it when the head is in position) are found the two maxillae, one on either side, and between the tips of the latter is a circular pad, the hypopharynx.

The compound eyes are always large, frequently contiguous above, and they contain a large number of hexagonal facets, sometimes of two different sizes. The antennae vary in shape and also in the number of segments, there being usually seven. In the Odonata the labium is unique because of its large size and great

mobility. It varies in form in different families and is important in classification.

Thorax.—The thorax is composed of four rings or body segments. Immediately behind the head is the microthorax, a very small incomplete ring composed of a small plate on either side. Following this is the prothorax, a larger segment, to which is attached the first pair of legs. The region of the prothorax, or in fact all parts of the thorax above, on either side, and below, may be known in a general way as notum, pleura (singular, pleurum) and sternum. The caudal margin of the pronotum is

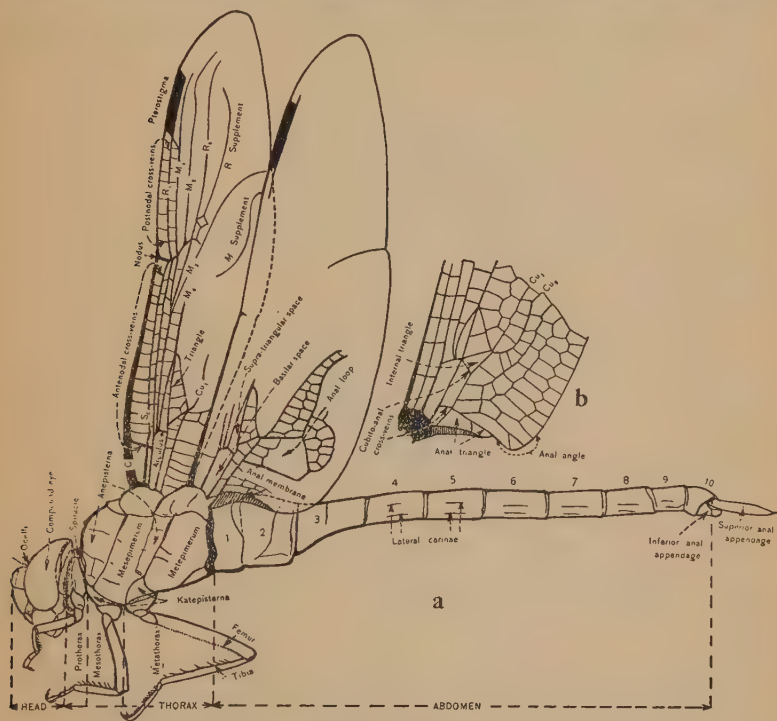


FIG. 2. Adult Anisopteron (*Anax junius*) showing parts.

usually provided with a thin transverse edge frequently projecting dorsad—a variable feature of use in classification. The pleura are divided into two sclerites by a line extending dorsad from the lateral articulations of the coxae or segment of the legs next the body. There is also a suture separating notum from pleura, but it is often obscure. None of the sclerites of the prothorax are of much taxonomic value except the pronotum.

The mesothorax and metathorax² (following the prothorax) are

² Sometimes called synthorax (Tillyard 1917, p. 22).

always fused in Odonata, and the dividing line is traceable with difficulty in adults. Except for the attachment of the second and third pair of legs and the wings, there is little to separate them to a casual observer.

It is important to bear in mind that the thorax and abdomen of all dragonflies are greatly modified and different in many respects from other insects. There are, however, the usual "landmarks" which facilitate a comparison of the sclerites in different groups. In the thorax these consist of processes or points of articulation of the appendages, particularly the legs, invaginations of the internal skeleton, and breathing pores.

The proximal segment of the legs, for instance, articulates with

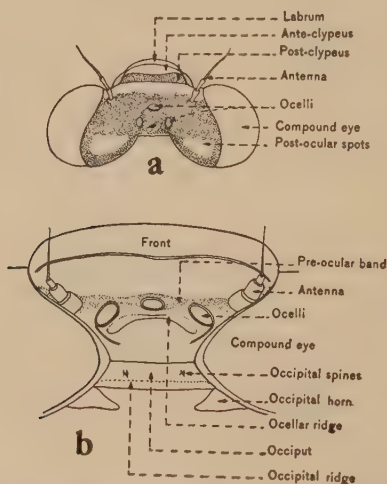


FIG. 3. Heads of Odonata from above. (a) Zygoptera, (b) Anisoptera (Ophiogomphus).

the body in concave sockets that have lanceolate or somewhat circular margins, with a lateral point or projection on each. The point may be easily located by following the lateral ridge of the coxa to the margin of the socket. Extending upwards from the lateral points there is always a suture in the body wall of the thorax which is important in separating the two sclerites, episternum and epimerum, of pro-, meso-, and metapleura. The meso- and metepisterna are divided in Odonata into a dorsal division (anepisternum)³ and a smaller ventral sclerite, the katepisternum.⁴ The notum of all thoracic segments except the first is

³ Formerly supracpisternum (see Comstock 1920, p. 51, for proper nomenclature).

⁴ Formerly infraepisternum.

very greatly modified, but here again the sclerites corresponding to other insects may be traced by means of internal invaginations of the skeleton. Close approximation of the legs and reduced area of the sterna are also confusing, and since both sternum and notum of meso- and metathorax are little used in classification, they will not be considered here. Along the anterior margin of the mesonotum on either side is a very large spiracle, a long, narrow slit near the mid-dorsal line, under the caudal margin of the pronotum. Just behind each spiracle in the Zygoptera there is a small plate known as the mesostigmal plate or lamina, which varies in some genera and affords a valuable means of determining the females of these groups. The most conspicuous spiracle, however, is located at a point near the dividing line between meso- and metathorax, on the anepisternum of the metathorax. This spiracle is smaller in size and elliptical or circular in outline. In front of the anterior wing bases are two small plates, the paraptera.

The wings and legs of Odonata are comparable to other insects, and the nature of both appendages is of great importance to systematists. The legs are composed of the following segments beginning with the proximal: coxa, trochanters (two segments), femur, tibia, tarsus (three segments). There are always two claws attached to the tip of the tarsus. Various shapes and sizes of setae are borne on femora, tibiae and tarsi.

The wings are apparently complexly veined, but analysis of the system of venation proves it to be homologous to that of other insects. The great number of supernumerary cross-veins is indeed confusing at first sight, but it is possible with a little study to follow the course of the larger primary veins and, when once acquainted with the general scheme, to find the characters for identification. Needham and Comstock attempted to homologize the veins with other insects, and their system for the Odonata has been accepted until recently. Tillyard and Lameere,⁵ however, believe that the original interpretation of Comstock and Needham is in error because of the disappearance of certain veins in the center of the wing, and they have modified the original interpretation to allow them to fit it more closely to the fossil record and also to other orders related to the Odonata.

Beginning with the fossil cockroaches of the Carboniferous period—in all probability the progenitors of modern insects—the wings contained a large number of veins. As conditions changed at the close of this geological period, the wings of many species became narrower, and there was an accompanying decrease in size, probably due to changing climatic conditions. At this time the

⁵ Perhaps the best expression of Tillyard's recent ideas along this line is found in the *American Journal of Science*, Vol. ix: 328-32: 1925, and Vol. x: 68-73: 1925. A translation of Lameere's work is found in *Psyche* xxx: 123-32: 1923. See also *Insects of Australia and New Zealand*, pp. 67-71: 1926, by R. J. Tillyard.

veins became fewer in number, some were lost, and forms appeared with venation very similar to those existing to-day. *Kennedyia mirabilis* Till., the oldest known dragonfly (recently discovered in the Permian of Kansas), has a wing very similar to the Zygoptera of today except that it is narrower and there are fewer cross-veins.

Three general tendencies in wing-vein reduction during the period following the Carboniferous may be noted: (1) Reduction in the costal area—the costal and anterior radial branches were much branched in Carboniferous forms. In later forms there is little branching of these veins. (2) Reduction in the number of primary veins in the anal area, and (3) the loss of one or two veins in the center of the wing by the crowding together of the wing at the base.

As already mentioned, two or more systems have been advanced to account for the curious venation of the dragonfly wing. That of Tillyard is in reality a modification of Lameere's system. Both Lameere's and Tillyard's works are the outcome of the work of Comstock and Needham, although important changes have been made necessary by the fossil discoveries mentioned. Tillyard's system is based primarily upon the presence of convex and concave wing veins which he is able to trace back through a series of forms to the Paleodictyoptera and Carboniferous Protodonata. It provides for six convex or plus veins and five concave or minus veins, the theory being that simple branches or bifurcations of the originals retain the same sign, and that veins appearing between these bear the opposite sign. Thus should Radius become two-branched, each branch would have the original sign, let us say plus (convex). Now should a third branch appear between these two and become connected at the base with either, it would bear the opposite sign, or in other words, would be a concave vein. One difficulty appears to lie in the fusion of veins and the resulting sign which the fused vein should receive—and it seems apparent that more work is needed, especially in the region of the triangle where the veins have been so profoundly altered. It is quite evident that Cu_1 has disappeared from the picture (see Fig. 4, a, b) and it is probable that the posterior branch of M has also disappeared. It should be noted further that the Rs of Needham is not the true Rs of other orders but is a recent development and in reality a minor offshoot of R_1 . The system of Tillyard and Lameere probably corresponds more fully with the true development of Odonata from the early geological periods, but since the system of Comstock is at present more widely known and generally used, and since all descriptions were drawn up before the advancement of Tillyard's theories, it is used in this paper. There will, no doubt, be a gradual change to the newer nomenclature as

other fossils are discovered and the work becomes better known. To facilitate a comparison, the following table, accompanied by the necessary figures (Fig. 4), is shown below. The Selysian system is also given. This was the first scheme to be generally adopted for wing-vein nomenclature and was devised by Baron de Selys-Longchamps. It has been replaced in recent years quite generally by the Comstock-Needham system.

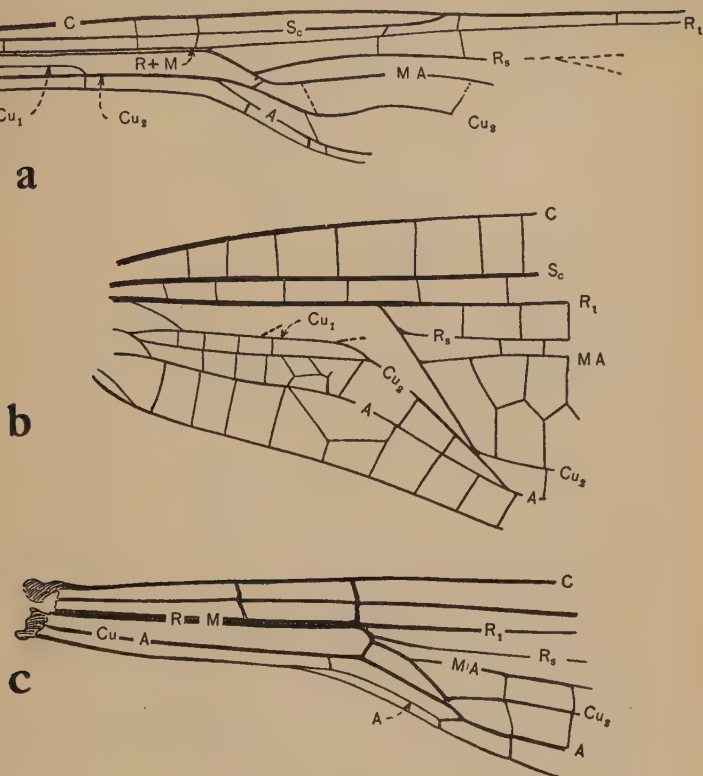


FIG. 4. Wing veins of fossil damselflies. (a) *Kennedyia mirabilis* Till. (b) *Tarsophlebiopsis mayi* Till. (c) *Chromagrion conditum* a modern species for comparison.

TABLE OF COMPARISON OF VENATIONAL SYSTEMS IN THE ORDERS
PROTODONATA AND ODONATA

(Convex veins marked +, concave veins —)

<i>Name of vein</i>	<i>Tillyard</i>	<i>Comstock- Needham</i>	<i>Selys</i>
Costa (+)	C	C	Costal Nervure
Subcosta (—)	Sc	Sc	Subcostal Nervure
Radius (+)	R	R	Median Nervure
Main stem (+)	R ₁	R	Median Nervure
Radial sector (—)	R _s (—)	M _{1-s}	Upper Sector of Arculus
	R _{2+s} (—)	M ₁₊₂	Principal Sector
	R ₂ (—)	M ₁	Principal Sector
	IR ₂ (+)	M _{1s}	Postnodal Sector
	R ₃ (—)	M ₂	Nodal Sector
	IR ₃ (+)	R _s	Subnodal Sector
	R _{4+s} (—)	M ₃	Median Sector
Media (—)	M	M (fused basally with R)	Median Nervure
Anterior branch (+)	MA	M ₄	Lower Sector of Arculus
Posterior branch (—)	MP*		(Short Sector)
Cubitus (—)	Cu	Cu	Submedian Nervure
Anterior branch (+)	Cu ₁ *		
Posterior branch (—)	Cu ₂	Cu ₁	Superior Sector of Triangle
Anal (—)			
Anterior branch (+)	IA	Cu ₂	Inferior Sector of Triangle
Posterior branch (—)	A'	A

* Regarded as absent except in the Protagriidae, a group of primitive Odonata from which the Agrionidae were probably derived.

The relative position of the different families in our scheme of classification has been outlined in the *Zygoptera* of Illinois, p. 463, 1917. It will be seen that the Agrionidae and Coenagrionidae are very close in point of specialization. Since this work was published it has become apparent from the work of Kennedy and Tillyard, who have considered the relationships from morphological and paleontological evidence that the original position of the Agrionidae as the most generalized and hence at the bottom of the list, is open to question. The structure of the genitalia and the discovery of *Kennedya* in the Permian of Kansas casts considerable doubt on the hitherto-accepted interpretation. There still remain, however, points which need clearing up. These are found in the important retention of the interpleural suture in the adult Agrionidae and the cleft and primitive condition of the labium of the Agrionid nymph. These facts, together with the fact that so few fossils are known from the Permian, would indicate that any position taken in regard to the relative generalization of these two families may be easily overthrown by future discoveries in paleontology or extensive work upon the morphology. Possibly the origin of both Agrionidae and Coenagrionidae may be carried

still further back into the Carboniferous and they may have arisen at approximately the same period. In view, however, of the evidence available at the present time, the original order of the families, Agrionidae and Coenagrionidae, is reversed, but this does not mean necessarily that either is more generalized.

The abdomen is composed of ten complete rings or segments variously modified and pigmented. The spiracles of the segments (except the first) are hidden completely by the overhanging terga and the pleura reduced to small membranes beneath the lateral edges. The sterna or sclerites of the ventral surface are often reduced to a line, or hidden entirely by the approximated terga, while on segments two and nine the sterna are modified to form the genitalia. The male genitalia of segment two, known as accessory, are unique, being found in no other order of insects. Their

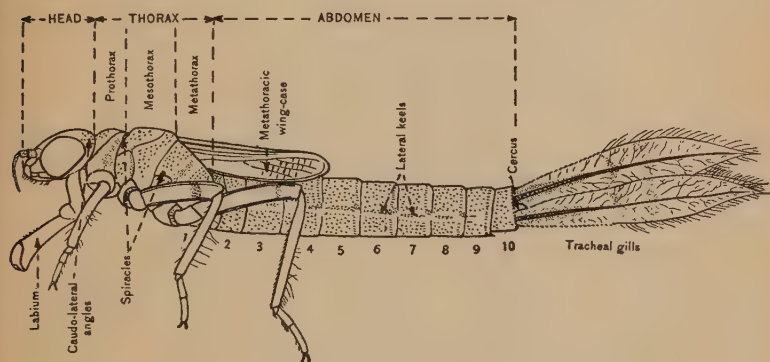


FIG. 5. Nymph of Zygopteron (*Ischnura verticalis*) showing parts.

structure, represented in Fig. 20, affords an important means of classification.

The ovipositor of the female, situated on segment nine, is shown in Fig. 26. The ovipositor, however, is frequently reduced to two small plates on the ventral surface (see Fig. 19). Attached to the tip of the tenth segment are the anal appendages. Their structure varies a great deal in the male sex and offers another important feature of classification.

Nymph

The nymph differs from the adult in many features. In the head, the appendages surrounding the mouth are essentially the same, but the labium is different, especially the shape of the labial palpi (Fig. 7). The marginal setae, mental setae, setae of the labial palpi and general form of the mentum are important in

classification. The ocelli are never present in the nymph and the compound eyes not often contiguous. The antennae are also different from the adult, especially in the families Gomphidae and Agrionidae, where certain segments are greatly enlarged.

Thorax.—The prothorax usually consists of a simple ring with a pair of legs attached. An indistinct line on the mid-dorsum divides the pronotum. The pleura are divided by a line running

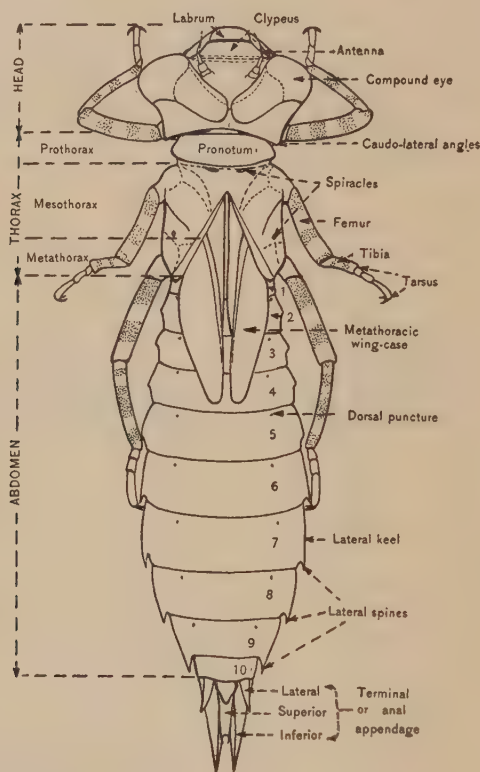


FIG. 6. Nymph of *Anisopteron* (*Basiaeschna janata*) showing parts.

dorsad from the coxal processes. The legs are not usually provided with heavy setae as in the adult, but the tibiae sometimes possess small scales at the tip. Meso- and metathorax are essentially the same as the adult in form, though sutures are not usually as distinct and the wings are, of course, undeveloped. All signs of wings are wanting in the first instars.

Abdomen.—The lateral margins of the abdomen are produced in the form of keels and variously adorned with spines and setae.

The mid-dorsal line is likewise produced and sometimes ornamented with very large hooks. At the tip of the abdomen there may be found either short, spine-like projections or long, leaf-like gills.

It should be remembered in studying dragonfly nymphs that there is more variation in the younger stages of a species than is usually found in the adult and that in species the adults of which are closely allied, there is no feature known which will put the nymph in its proper place. It therefore behooves the student, if he desires a more accurate determination, to rear the specimen considered, whenever the individual belongs to a group of closely related species. Characters are now available, however, which enable one to refer most species to their proper families and genera with certainty, and it is probable that continued study will show constant characters of sufficient importance to enable separation of the more closely related species, in the earlier stages.

HOW TO DISTINGUISH THE SEXES

Separate keys to the sexes are found in many places below, and it is important to know the male and female in order to make satisfactory determinations. The male is easily recognized by the presence of accessory genital appendages on the ventral surface of the second abdominal segment. This character is always present and easily found. The anal or terminal appendages of the male consist either of two upper and two lower, or two upper and one lower of characteristic shape. The males of some groups possess an anal triangle (Fig. 4, b), a secondary character. Females usually have a prominent ovipositor, though this is sometimes modified and frequently reduced. There are no accessory genitalia and the anal appendages consist of simple cerci and larger ventral processes.

VARIABILITY IN THE ODONATA

There is sometimes considerable variation in the Odonata, both in color and size. Specimens described from Connecticut may be smaller or larger than those found in other localities, but as a rule this variation should be within five millimeters of the dimensions given. Occasional examples will naturally occur that may be stunted from lack of food or, having found conditions more favorable, may be larger than those described. Even wing veins show variation in number, especially cross-veins, which is to be expected, since this part of the dragonfly has undergone rapid evolution. It is well known that dragonflies change color as they become older, the brighter colors being replaced by duller hues,

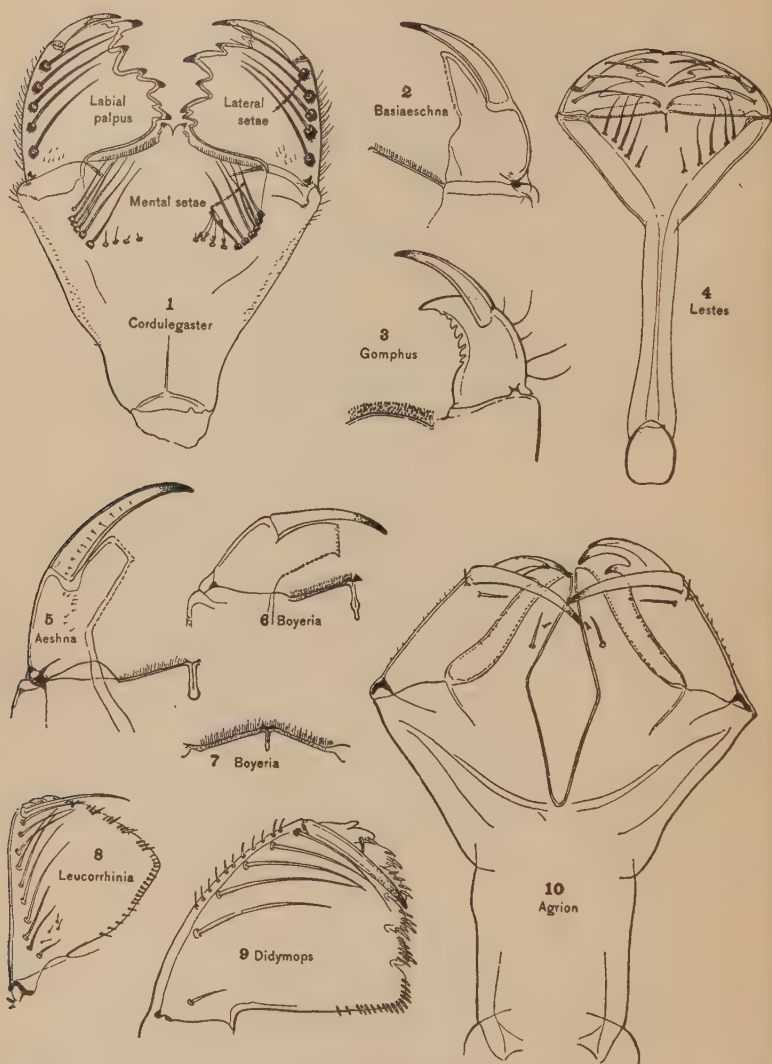


FIG. 7. Labia of nymphs.—1. *Cordulegaster* sp. 2. *Basiaeschna janata* labial palpus. 3. *Gomphus* sp., palpus and distal margin of mentum. 4. *Lestes vigilax*, labium. 5. *Aeshna umbrosa*, palpus. 6. *Boyeria vinosa*, palpus and distal margin of mentum. 7. *Basiaeschna janata*, distal margin of mentum. 8. *Leucorrhinia intacta*, palpus. 9. *Didymops transversa*. 10. *Agrion maculatum*, labium.

which in turn often become pollinose, due to waxy secretions. Preserved specimens may also present a totally different appearance from the freshly collected specimens, especially if means are not taken to prevent discoloration. Such variations in the Odonata should make one cautious about determinations, and he should base them primarily upon structure wherever possible.

COLLECTING AND PRESERVING

To collect adult dragonflies, a light and stout net should be available. Landing nets of convenient size are on the market, the best of which consist of a handle of two sections and two flat pieces of spring steel which fold together longitudinally and open out to make the rim of the net. This net is about fourteen inches

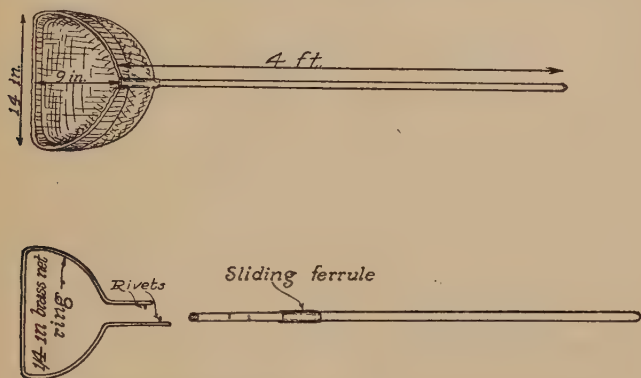


FIG. 8. Diagram of net for collecting nymphs designed by Mr. B. H. Walden.

in diameter with a handle two to four feet long according as one or two sections are used. The bag itself should have a margin of heavy cloth to fit over the rim, since most of the wear comes at this point, and should be composed of good quality bobbinet or bolting cloth. Bolting cloth makes a very satisfactory outfit. Such a net should be about eighteen inches in length and should taper gradually from mouth to tip.

For collecting nymphs, a fixed, solid, semicircular rim is preferred to a jointed one such as the landing net just described. This may be welded to a piece of two and one-fourth inch coupling and a pole screwed into the pipe, or may be attached to the handle, preferably a long one, by various means. A simple and easily constructed water net designed by Mr. B. H. Walden is shown in Fig. 8.

If much collecting is done, some sort of carrying satchel should be provided. Williamson constructed an ideal bag which is composed of a leather case ($7\frac{1}{2} \times 11$ inches by $8\frac{1}{2}$ inches high) into which he fits a series of tin boxes of assorted sizes, allowing him to shift them with ease and still keep his material separate. He has attached to the rear of the bag a ring which fastens to the belt and keeps the bag at the back when stooping or running. Small hunting bags which serve the purpose fairly well may be had on the market and are suitable for collecting dragonflies.

It is well to give more attention to preserving specimens after they are collected, however, than to waste too much thought and time over the manner of collecting.

Nymphs are well preserved in 80% alcohol. Formalin should not be used, or heat, except perhaps 1% formalin in 80% alcohol. Adults, if placed in 80% alcohol, are preserved admirably, including colors. Reared specimens should be preserved in alcohol, since nymphal skin and adult may be kept together more easily than if pinned. Dr. Calvert, however, mounts exuviae of damselfly nymphs on a square of mica, covering the whole with transparent cement, and pins it with the adult. If specimens are reared, care must be taken to allow full color to develop in the adult. Some workers while collecting keep on the alert for emerging nymphs, which may often be found along the banks, on weeds and shrubs; these they place in paper bags until fully colored and developed and do not kill until then. One cannot be too careful, however, in this kind of collecting to associate the proper exuviae with the adult that emerged from it.

For killing adults, bottles about two inches in diameter and four in height should be obtained. Sodium cyanide in pieces the size of a pea or smaller should be scattered over the bottom and sealed in place by pouring in plaster of paris and water about the thickness of cream. If desired, sawdust may be placed over the cyanide and held in place with circles of cardboard. Smaller killing bottles may be constructed of thick-walled test tubes with sawdust and cyanide kept in place with cardboard or heavy blotting paper cut with a gun-wad punch.

Care must be taken not to allow killing bottles to become moist, since dragonflies coming in contact with moisture saturated with cyanide are quickly spoiled. To this end bottles should be aired before using, allowing the plaster to set and become hard and the excess moisture to escape. Still further care should be taken to clear out the cyanide bottle or tube frequently while collecting, removing the contents to envelopes or small boxes.

After killing, all specimens must be dried thoroughly and may be stored then in boxes or triangles of paper. If it is desirable to spread the wings, a setting board such as is used for moths

and butterflies is convenient. The length of time required to thoroughly fix the wings depends upon the size of the specimens and the place where they are kept; but the process may be hastened by placing in an oven and heating gently. If heat is not applied, at least two weeks should be allowed for the specimen to dry. It is essential to dry all specimens quickly in order to preserve their colors, and drying by artificial heat is to be recommended for this reason. It is important, before finally mounting, to support the body by running a fine bristle or pin through the head, thorax and abdomen. This keeps the various sections of the body together and prevents breakage, which is one of the worst troubles in maintaining a collection of dragonflies.

Williamson dries all specimens in triangles of paper, later pinning those which he desires through the base of the wings. To dry specimens while on collecting trips, he has constructed a box with a funnel-shaped cloth which fits on the bottom. This he hangs on a tree over a lantern.

For rearing Zygoptera, jelly tumblers may be used conveniently and successfully. There should not be more than one individual in each tumbler, since the nymphs will kill one another, and a small piece of water weed taken from the habitat of the nymph should be placed in the water. Sphagnum moss also serves this purpose, and is adapted to the needs of Zygoptera. Anisoptera require larger jars or cages, but unless the cage is large, only one individual should be placed in each. Various kinds of cages have been used in rearing dragonflies in the field, most of them consisting of a simple wire cage placed in shallow water.

Mosquito larvae may be used for food for the nymphs, or any soft-bodied aquatic larvae. Ephemerids are particularly desired by many species. Full-grown nymphs are better for rearing than the younger stages and may be distinguished from the latter by means of the wing pads, which are well filled out in the older stages. Some workers have reported the successful use of angle-worms for food, and the larger species of dragonflies will take live, soft-bodied insects such as flies, roaches, spiders, or small caterpillars, if held before them.

ILLUSTRATIONS

For photographing tracheal gills, the writer has used the following method: The gills are detached and mounted in water, using gills from newly captured nymphs if possible. They are then placed beneath the camera provided with a 48 mm. or 32 mm. lens, are lighted from below with a mirror or incandescent light, and photographed. Wings have been successfully photographed by¹ removing from the insect, mounting between lantern-slide

cover glasses and then placing in an enlarging camera with a 300-watt light and reflector, the image being thrown upon a 5 x 7 plate. This gives a sharp image from which prints may be made the same as with direct photography. Photographs have been made of the wings of more valuable specimens by placing them on a sheet of white paper and making the exposure. In photographing mounted labia in balsam or damar, it is advisable to use a color screen, preferably a yellowish green or light brown.

Drawings may be made with the aid of an ocular net micrometer and cross-section paper, allowing each square of the cross-section paper to correspond to a square of the net micrometer placed in the ocular of the microscope. A few photographic tracings have also been made, the image being bleached out after ink was applied. The camera lucida is also useful in making illustrations, and there are other mechanical devices which aid materially in the process. All of them, however, must be supplemented by some personal efforts, for otherwise satisfactory results will not be obtained.

All illustrations used herein are original unless otherwise credited.

PART II: TAXONOMY

Key to Suborders

Nymphs

1. Nymphs with three caudal tracheal gills attached to the tip of the abdomen, consisting of flat plates traversed by tracheae
Zygoptera, p. 35
- Nymphs without caudal tracheal gills, usually with small spinose appendages at the tip of the abdomen.....**Anisoptera, p. 115**

Adults

1. Front and hind wings nearly similar in shape, their greatest width nearly or quite the same; anal appendages of the male always four in number, two superior and two inferior ...**Zygoptera, p. 35**
- Front and hind wings not at all similar in shape; greatest width of the hind wings more than the greatest width of the front. Anal appendages of the male usually three in number, two superior and a single broad inferior¹**Anisoptera, p. 115**

Suborder Zygoptera Selys

Zygoptera or damsel flies may be recognized by their delicate form, the abdomen being slender in proportion to the rest of the body. Their flight is slow and uncertain because of the lack of rigidity in their wings, owing to the presence of few cross-veins. When at rest, the wings are held vertically, except in the genus *Lestes*, the species of which alight with half-open wings.

The nymphs are also slender in form, and possess long flattened tracheal gills attached to the tip of the abdomen.

Key to Families

Nymphs

1. Lateral gills triquetral or three-sided; first antennal segment as long as the remaining segments together**AGRIONIDAE, p. 108**
- Lateral gills flat, not three-sided; first segment of the antennae shorter than the remaining segments together
COENAGRIONIDAE, p. 35

Adults

1. Interpleural suture well developed (distinct as far cephalad as the metathoracic spiracle and usually visible beyond this point); bright metallic colors frequently present**AGRIONIDAE, p. 108**
- Interpleural suture only partly or not at all developed; bright metallic colors rarely present**COENAGRIONIDAE, p. 35**

Family COENAGRIONIDAE Kirby

The nymphs have only flattened tracheal gills and the mentum is never cleft as far proximad as the articulation of the labial palpi.

Adults of this family are frequently marked with bright blue or

¹ According to Crampton, the inferior appendage of Anisoptera is not homologous to the inferiors of the Zygoptera. See Bull. Brooklyn Ent. Soc. 13: 49-68: 1918, pls. 2-7.

green. The antenodal cross-veins are never more than two in number in our species and the nodus is usually from one-third to one-fifth the distance from the base to tip of the wing.

Key to Subfamilies

Nymphs

1. Labium much contracted at base, not triangular in outline, the contracted portion as long as the expanded; gills as in Plate 1, Figs. 1-6, usually smoky or brown, and the tracheal branches inconspicuousLESTINAE, p. 93
- Labium not contracted at base, triangular in outline; gills usually clear or with smoky cross-bands, the tracheae much branched and frequently conspicuousCOENAGRIONINAE, p. 36

Adults

1. M_3 arising much nearer the arculus than the nodus or subnodus; supplementary sectors present between R_3 and M_3 and between M_3 and M_4 ; anal appendages of the male forcipate and usually much longer than the tenth abdominal segmentLESTINAE, p. 93
- M_3 arising much nearer the nodus or subnodus than the arculus: no supplementary sectors between M_3 and M_4 ; anal appendages of the male not forcipate and not exceeding the tenth abdominal segment in lengthCOENAGRIONINAE, p. 36

Subfamily COENAGRIONINAE Kirby

The nymphal gills differ from those of the *Agrioninae* and *Lestinae*, usually possessing more conspicuous tracheae. The abdomen is less slender, and the median lobe of labium is more nearly triangular and not greatly contracted, proximad in our species.

Adults of the subfamily are usually marked with stripes or spots of blue, or yellow, but a few species are uniform metallic green above. The wings contain fewer irregular cells than the *Lestinae* and nearly all primary veins are straight almost to the margin of the wings.

Key to Genera

Nymphs

1. Gills half as broad as long; labium without mental setae *Argia*, p. 85
- Gills not more than one-third as broad as long; labium provided with mental setae 2
2. Caudo-lateral angles of the head projecting and forming a blunt tubercle, the margins of the head much contracted between the tubercles and the eyes 3
- Caudo-lateral angles of the head not projecting and forming a blunt tubercle; the margins of the head not contracted between the tubercles and the eyes 4
3. Gills without cuticular pigment; one-third as broad as long, the margins thickly provided with heavy setae which extend from the base to the apex of each*Amphiagrion*, p. 48
- Gills with considerable cuticular pigment; not more than one-sixth as broad as long, the margins sparsely setose (Pl. II, Fig. 2) *Chromagrion*, p. 46

- 4. Gills with tracheal branches much more numerous at the widest portion of the gill; abdomen with small white spots on a dark background **Nehallenia**, p. 49
- Gills with tracheal branches equally distributed throughout the length of the gill; abdomen with brown spots on a light background 5
- 5. Gills with blunt points, or if with long points, then the cuticular pigment other than in cross bands; mental setae usually three, or three with a minute fourth (four in *E. calverti* and *E. cyathigerum*) **Enallagma**, p. 54
- Gills with long tapering points; the cuticular pigment, if present, always in cross bands; mental setae of the labium usually four 6
- 6. Gills without cuticular pigment; no dark spots at bases of abdominal spines; nymphs of small size, full-grown individuals rarely more than 14 mm. in length including gills (Pl. II, Fig. 7) **Anomalagrion**, p. 38
- Gills usually with cuticular pigment in the form of arcuate cross bands; cuticular spots present and prominent on abdomen and keels; nymphs larger, when full grown 16.5-20 mm. in length including gills **Ischnura**, p. 40

Adults

- 1. Cephalic row of setae of middle and hind tibiae twice as long as the intervals between their bases; postnodal cross-veins of the front wing twelve or more in number; M_2 arising between cross-vein 5 and 9 in the front wing **Argia**, p. 85
- Cephalic row of setae of middle and hind tibiae less than twice as long as the intervals between their bases; postnodal cross-veins of the front wings usually less than twelve in number;² M_2 arising between the third and fifth, rarely sixth postnodal cross-veins in the front wing 2
- 2. Dorsum of thorax metallic green or bronze **Nehallenia**, p. 49
- Dorsum of thorax not metallic green or bronze 3
- 3. Postocular spots wanting; mesopleural suture without a black stripe 4
- Postocular spots present; mesopleural suture with a black or dark brown stripe 5
- 4. Dorsum of abdominal terga 1-6 entirely reddish or buff; female with a heavy spine on caudal margin of the eighth sternum **Amphiagrion**, p. 48
- Dorsum of abdominal terga 1-6 black; female without a heavy spine on the caudal margin of the eighth sternum **Chromagrion**, p. 46
- 5. M_2 usually arising between the fourth and sixth postnodal cross-veins in the front wings and between the third and sixth in the hind (Fig. 9, No. 3) 7
- M_2 usually arising between the third and fourth postnodal cross-veins in the front wings and between the second and third in the hind 6
- 6. Dorsum of the fourth abdominal tergum black, except a narrow basal ring; stigma of the front wing of the male not remote from the margin (Fig. 9, No. 7) **Ischnura**, p. 40
- Dorsum of the fourth abdominal tergum yellow with the exception of a basal and apical spot in the male and a small apical spot in the female; stigma of the front wing of the male remote from the margin (Fig. 9, No. 8) **Anomalagrion**, p. 38

² More than 12 in *Chromagrion* and occasionally in *Enallagma*.

7. Cu_2 terminating between nodus and origin of M_2 ; length of male abdomen 35 mm. (Fig. 42, No. 1) **Teleallagma**, p. 53
 Cu_2 terminating at or beyond the origin of M_2 ; length of male abdomen not over 30 mm. (Fig. 9, No. 3) **Enallagma**, p. 54

Genus *Anomalagrion* Selys

Nymphs.—Head with rounded caudo-lateral margins, the labium with mental setae; lateral keels usually spinulose; abdom-

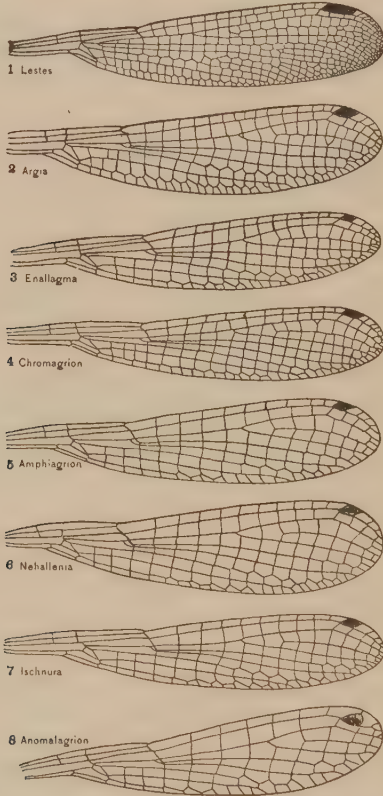


FIG. 9. Front wings of 8 different genera of Coenagrionidae.

inal cuticle brown, very faintly spotted or not at all; gills less than half as wide as long, usually without cuticular pigment, but with comparatively inconspicuous tracheae, the latter not more numerous at the widest portion of the gill; gills with long tapering points; total length including gills (full grown) about 14 mm.

Adults.—Postocular spots present; wings with 6-9 postnodal cross-veins in the front wings and M_2 arising between the third and fourth of these; stigma of male remote from the margin;

dorsum of thorax not entirely metallic green, usually yellow and black, and the caudal margin of the prothorax entire; tibial setae (middle and hind) shorter than the intervals between them and the mesopleural suture usually lined with black; abdomen with terga 1-6 orange or yellow and black; female with a ventral spine on segment 8.

Anomalagrion nymphs are difficult to distinguish from the nymphs of *Ischnura*, but are usually of smaller size; the lateral setae are five in number and the abdomen is not as prominently spotted. In addition, the smaller tracheae of the gills are inconspicuous, especially towards the margins of the widest portions, as shown in Pl. II, Fig. 7. Of the *Ischnuras* the species *posita* gives the most trouble, and apparently the only satisfactory character for separating them is found in the gills, which are much more prominently banded than in other members of the genus or the genus *Anomalagrion*.

The only adults of this genus which I have collected in Connecticut were found near brackish water not far from Long Island Sound. It does not seem, however, that this is the normal habitat of the adult. It has been seen and collected by others in quite different localities and the nymphs are known to inhabit small fresh-water pools or ponds.

***Anomalagrion hastatum* (Say)**

Journal of the Academy of Natural Sciences of Philadelphia, 8: 38: 1839.

Nymph.—Color green or buff.

Head: with rounded caudo-lateral angles; antennae with first two segments brown in color, the remaining ones lighter; labium not extending caudad of the procoxae, the median lobe about as broad as long; mental setae 4, lateral setae 5.

Thorax: legs without dark rings; wing-cases extending nearly to the fourth abdominal segment.

Abdomen: lateral keels feebly developed and with minute spines, gills (Pl. II, Fig. 7) lanceolate and with a long point; dorsal marginal spines of the median gill consisting of a thick row, extending about one-third the length of the gill from the base; ventral marginal spines of the lateral gills extending slightly further from the base than the dorsal row; ovipositor extending to the caudal margin of the tenth abdominal segment.

Measurements: length, 9.5 mm.; length of abdomen, 5.5 mm.; length of gills, 4.5 mm.; width of gills, 1.0 mm.; length of median lobe, 1.6 mm.; width of median lobe, 0.5-2.0 mm.

Adult, male.—Color pale lemon-yellow and black.

Head: lemon-yellow and metallic black or green; antennae brown except the proximal segment, which has a pale stripe from the base to the apex; postclypeus black, lateral margins sometimes

pale; anteclypeus pale, labrum with a transverse black stripe on the dorsal margin, the remainder yellow; exposed portion of the mandibles, their trochantins, genae, and front above the clypeus to bases of the antennae yellow; remainder of front dark; postocular spots very small, nearly circular, and not connected with the postocellar stripe; occiput and postgenae mostly yellow.

Thorax: dark metallic green and yellow; pronotum dark, the cephalic lobe lined with yellow and the caudal lobe with three yellow spots; mesepisterna dark with a narrow greenish line above the mesopleural suture; dorsal half of the katapisterna and the epimera dark; metathorax and ventral surface of the thorax pale yellow; legs yellow with a short dark dash on each femur near the apex; tibiae mostly pale; tarsi and claws pale, darker at tips; wings delicate, postnodal cross-veins 5-9 in the front wings, and 4-6 in the hind; stigma of the front wing ovoid and remote from the margin but connected with it by a cross-vein.

Abdomen: yellow or orange, and black, with black longitudinal bands on terga 1-3 and 7, those on 3 and 6 being reduced to basal and apical spots; terga 8-10 yellow; tenth tergum with a long process bifid at tip, and about as long as the segment itself. Anal appendages (Fig. 10, No. 20) small, the superiors bifurcate, each with a broad rounded mesal lobe and slender lateral one; inferiors conical, slightly longer than the superiors.

Female.—Color orange and black or dark brown.

Head: differing from the male in having the black of the postclypeus reduced to a dorsal line and that of the labrum to lateral spots; postocular spots wanting; occiput and postgenae pale.

Thorax: dorsal black stripe covering half of each episterna; mesopleural suture with a pale line, remainder of thorax orange or buff. Wings with stigma in contact with the margin.

Abdomen: orange with narrow basal black rings on terga 2-4 inclusive; a longitudinal dark stripe on the caudal three-fourths of 5, similar stripes extending the full length of 6, 7 and 8; tenth tergum with a short blunt projection; ovipositor extending beyond the anal appendages.

Measurements: total length, male 23-24, female 24 mm.; length of abdomen, male 17-19, female 19 mm.; length of hind wings, male 10, female 14 mm.; width of hind wings, male 2, female 2-2.5 mm.

Connecticut.—East Haven, 29 July, 1921 (B. H. W.); Branford, 11 August, 1921 (P. G.).

New England.—June 22-August 20.

Genus *Ischnura* Charpentier

Nymphs.—Head with rounded caudo-lateral angles, the labium with mental setae; abdomen with spinulose lateral keels; gills less than half as broad as long, with or without cuticular pigment,

but usually with pigment in arcuate cross-bands; gills with long tapering points; length when grown (including gills) about 20 mm.

Adults.—Head with postocular spots; wings with 7-9 post-nodal cross-veins; the stigma about as wide as long and never remote from the margin in the male; dorsum of thorax never entirely metallic green, and the caudal margin of prothorax entire; tibial setae usually shorter than the intervals between them, never twice as long; mesopleural suture covered with black; abdominal terga 1-6 never entirely red or buff, usually black with pale rings, the basal segments sometimes red; female with or without a ventral spine on 8.

A genus commonly found in Connecticut although there are only four species represented. This is a small-pond and weedy-lake genus, and all of the species with the possible exception of *kellicotti* may be found near such bodies of water. The eggs are probably laid in the stems of plants below water.

Key to Species

Nymphs

- 1. Gills with usually more than two distinct arcuate cross-bands and a blotch on the tip of the gill; lateral setae of the labium five .**posita**
Gills with one or two cross-bands or none—never with four;
lateral setae of the labium usually six**verticalis**

Adults

Males and Females

- 1. Mesopleural pale stripe interrupted at the caudal third to form a distinct exclamation point**posita**
Mesopleural pale stripe not interrupted at the caudal third to form a distinct exclamation point 2
- 2. Eighth sternum of female with a long spine; dorsum of ninth tergum black **ramburii**
Eighth sternum of female without a long spine; dorsum of ninth tergum blue or black 3
- 3. Seventh tergum with more or less blue on the dorsum; stigma usually blue beneath; anal appendages as in Fig. 10, No. 16 ...
[**kellicotti**]
Seventh tergum black; stigma not usually blue beneath**verticalis**

Ischnura posita (Hagen)

Synopsis of the Neuroptera of North America, 77: 1861.

Nymph.—Color usually dark brown.

Head: with few spinules on the caudo-lateral margins, the margins evenly rounded, not projecting; second antennal segment light at tip; labium extending between or slightly behind the procoxae. Mental setae 4, sometimes a small fifth; lateral setae 5.

Thorax: femora with rows of heavy setae, tarsi pale, the apices of the third segments brown; metathoracic wing-cases extending to the fourth abdominal segment.

Abdomen: cuticle provided with numerous small black spots, each bearing a single seta; lateral keels without spines, except those of the segments 4 or 5 to 8; gills (Pl. II, Fig. 6) lanceolate, broadest beyond the middle, and usually with 4 crescentic brownish bands, of which the 3 apical ones are paler; median gill with a dorsal row of about 14 spines extending one-third the length of the gill from the base; ovipositor extending to the apex of the tenth abdominal segment.

Measurements: length, 11.5 mm.; length of abdomen, 7.5 mm.; length of gills, 5-5.5 mm.; width of gills, 1.6 mm.; length of median lobes, 2.0 mm.; width of median lobe, .5-1.6 mm.

Adult, male.—Color black and yellow.

Head: antennae uniform dark brown; labrum black on the dorsal border, the black area projecting ventrad a little on the meson; genae, mandibles, and the front to the antennae yellow; remainder of the front and vertex black, the postocular spots yellow and almost circular; postgenae and occiput yellow.

Thorax: black and yellow; mesepisterna with short yellow stripes and spots adjacent to the paraptera, the two forming an exclamation point on each side of the dorsal carina; thorax yellow below; legs black and yellow, the femora pale with a dorsal black stripe on each from bases to apices, the stripe widened subapically; tibiae with a dorsal stripe on each from bases to the apices, the stripes fading into brown at apices; tarsi and claws pale, darker at tips; wings with 6 to 8 postnodal cross-veins in the front wing and M_2 arising between the third and fourth postnodal veins in the front and between the second and third in the hind.

Abdomen: black and yellow; terga 1-10 dull black with exception of a narrow basal ring on segments 3-7, the stripe narrowed on segment 2 at apex and widened on 3-6, lateral margins of the terga pale; apex of the tenth tergum with a mesal elevation, the elevation forming two small tubercles; anal appendages (Fig. 10, No. 12) small, orange in color, the superiors large and blunt, the inferiors bilobed, the superior lobe with small teeth.

Female.—Color pale blue and black.

Head: postocular spots blue.

Thorax: pale blue and black, sometimes lacking the black stripes on the metapleural sutures; occiput usually yellow, sometimes partly black; mesostigmal plates without an elevated ridge.

Thorax: black and yellow; pronotum mostly black, the cephalic lobe sometimes partly yellow and the caudal lobe with a pale spot on each lateral angle; mesepisterna with yellow stripes, and spots adjacent to the wing bases, the two together forming a distinct exclamation point on each side; dorsal half of the mesepimera black, the black stripe widened just behind the katapisterna; metathorax and the postcoxal areas yellow; legs black and yellow; tarsi and claws pale, darker at tips; wings short, 6-9 postnodals

in the front wing and M_2 arising between 3 and 4 in the front wing and between 2 and 3 in the hind; abdomen with the pale and black markings similar to those of the male, but there is a tendency for the terga to become pollinose.

Measurements: total length, male 24-27, female 27-29 mm.; length of abdomen, male 19-21, female 18-22 mm.; length of hind wings, male 12-13, female 13-16 mm.; width of hind wings, male 2.5, female 2.5-3.5 mm.

Connecticut.—Stratford, 9 July, 1920; Guilford, 13 July, 1920 (P. G.); New London, 8-22 June, 1921 (R. H. H.).

New England.—May 25-September 18.

Ischnura ramburii Selys

Revue des Odonates ou Libellules d'Europe: 186: 1850.

Nymph.—Unknown.

Adult, male.—Color green and yellow, and black.

Head: labium and face below the basal segments of the antennae yellow, with postclypeus and dorsal margins of labium black; basal segment of the antennae with a pale yellow spot, remainder black; dorsum of head above the antennae very dark green, the postocular spots circular, and pale blue; rear of head yellow, black on each side of occipital foramen.

Thorax: yellowish green and very dark green, the pronotum dark with pale lateral spots and cephalic margin; coxae mostly pale; femora black above, pale below; tibiae and tarsi black or very dark brown, claws darkest at tips. Mesothorax dark, with a very narrow pale line on each anepisternum, the epimera with ventro-lateral margins pale; each metapleura yellow with a black line on the metapleural suture; venter of thorax pale.

Abdomen: dark green, nearly black, the first two terga greenish on sides, 3-7 inclusive with lateral margins yellow; narrow pale basal rings on 3-6 or 7, the rings interrupted on the dorsum; tergum 8 entirely blue, 9 black above, blue on sides, 10 black, the segment, however, yellow beneath; anal appendage (Fig. 10, No. 8) dark brown, the inferiors paler at base.

Female.—One specimen in our collection has markings identical to the male in nearly all particulars. In some, however, the thorax is a reddish-orange color, and the head is also of this same color. The first abdominal segment and base of the second is also orange.³ In the orange female there is a mid-dorsal but no lateral thoracic stripe. Mesostigmal plates each with transverse ridge, the mesal half being somewhat higher, the lateral half of plate pale.

Measurements: total length, male 31, female 34 mm.; length of abdomen, male 24, female 26 mm.; length of hind wings, male

³ Calvert, P. P., Trans. Am. Ent. Soc., xx, 240; 1893.

16, female 18 mm.; width of hind wings, male 3.5, female 4 mm.; length of pterostigma, .75-1 mm.

Connecticut.—Collected at Branford (Indian Neck), August 11, 1921 (P. G.), and at North Haven, August 10, 1921, by Dr. Britton.

New England.—July 20-October 2.

Ischnura verticalis (Say)

Journal of the Academy of Natural Sciences of Philadelphia, 8: 37.

Nymph.—Color green or brown.

Head: caudo-lateral margins with spines, first two antennal segments and proximal third of 3 dark in color, remainder pale; labium extending caudad of the procoxae; median lobe with 4 or 5 mental setae and 6 lateral setae on palpi.

Thorax: femora with preapical brown rings; metathoracic wing-cases extending to the middle of the fourth, sometimes nearly to the fifth abdominal segment.

Abdomen: with lateral keels, cephalic two-thirds of the dorsum of which are provided with small setae evenly distributed over the keel; the keels of segments 2-7 are light at the apices; cuticle thickly provided with small black dots, each bearing a small seta, the caudal margin of each segment, however, without setae, but with short, white longitudinal dashes, especially marked on the venter; gills (Pl. II, Fig. 1) with long tapering points; the spines of the median gill extending less than half the length of the gill from the base; apices of the gills with long hairs; gill pigment usually in the form of arcuate cross-bands, of which there are usually two, but they may be entirely wanting, especially in younger nymphs; ovipositor of female extending to the middle of abdominal segment 10 or a little beyond.

Measurements: length (without gills), 13-14 mm.; length of abdomen, 9-10 mm.; length of gills, 6-7 mm.; width of gills, 1-1.3 mm.; length of median lobe, 1.8 mm.; width of median lobe, .6-1.6 mm.

Adult, male.—Color black or dark metallic green and pale green.

Head: black and yellowish green; postclypeus black, shining; anteclypeus, labrum, mandibles, their trochantins, genae and front above the clypeus, largely yellowish green; postocular spots large and subcircular; vertex and front except the transverse area above the clypeus dull black; occiput black and greenish yellow.

Thorax: greenish black and greenish yellow; pronotum shining black, except the front lobe; propleura largely yellow, mesothorax shining black with a yellowish stripe just above the mesopleural suture; ventral half or two-thirds and the cephalic shoulder of the mesepimera yellow; paraptera with a yellow spot ventrad of the lateral angles, the remainder black; mesostigmal plates black, the caudal margins elevated and yellow; metathorax

including the postcoxal areas greenish yellow, the metapleural suture, however, sometimes black; legs striped, the femora black or dark above, the dorsal stripes of the tibiae narrower; tarsi and claws pale, darker at apices; wings with 6-9 postnodals, and M_2 usually arising between the third and fourth postnodal (occasionally beyond) in the front wing and between the second and third in the hind.

Abdomen: shining black or green, and yellowish green, dorsum of terga 1-7 black or green, with pale basal rings and lateral margins; dorsum of 8 and 9 blue with dark lateral dashes, one on each side, the dash extending about three-fourths the length of the segment from the cephalic margin; anal appendages (Fig. 10, No. 4) composed of flattened, almost vertically placed superiors, the inferiors longer; dorsum of segment 10 strongly elevated and with two small tubercles.

Female.—Color orange and black or entirely black, tip of abdomen sometimes with blue; all markings often obscured with pollen in older specimens. Mesostigmal plates and hind margin of pronotum as in Fig. 11, No. 12.

Orange variety.—Head and thorax similar to the male except that all pale marks are orange instead of greenish yellow; post-ocular spots large, sometimes connected with pale color of occiput; femora usually pale above; abdomen with first two, and four-fifths of the third terga orange, remaining terga black above.

Black variety.—Similar to the male except that the dorsa of all terga are black.

Blue-tipped variety.—Greenish yellow of the male replaced by pale blue, the dorsa of terga 8 and 9 marked with bright blue, in some similar to the male, with a black stripe on each side; in others with irregular blue spots above.

The black and orange varieties of the female are regarded by some as different stages in the development of the insect, and the blue-tipped form may also represent an early stage. A majority of the specimens taken in midsummer will be found to be the black or pollinose variety, in which state it is necessary to rely on wing veins and the mesostigmal plate for determination. The plate in all varieties is black, with pale lateral angles, and the caudal margin elevated and forming a conspicuous ridge the full width of the plate (Fig. 11, No. 12). The caudal lobe of the pronotum is also different from *Enallagmas*, being provided with a double margin of peculiar form.

Measurements: total length, male 23-30, female 26-30 mm.; length of abdomen, male 18-25, female 23-24 mm.; length of hind wings, male 11-17, female 16-17 mm.; width of hind wings, male 2-3.5, female 3-3.5 mm.

Connecticut.—South Manchester, 3 August, 1896 (W. C. S.); Mount Carmel, 23 June, 1902 (E. J. S. M.); Poquonock, 9 July, 1903 (W. E. B.);

Hamden (Lake Whitney), 17 June, 1904 (H. L. V.), 23 May, 1906 (B. H. W.), 28 May, 28 June, 4, 18 July, 1920 (P. G.); West Thompson, 12 July, 1905 (H. L. V.); Portland, 15 August, 1913 (B. H. W.); Stratford, 9 July, 1920; North Colebrook, 19 June, 1920 (P. G.); New London, 6-22 June, 1921 (R. H. H.).

New England.—May 14-September 26.

Genus *Chromagrion* Needham

Nymphs.—Head with caudo-lateral angles projecting and forming a blunt tubercle; labium with mental setae; lateral keels not spinulose; gills less than half as broad as long, with considerable cuticular pigment and without conspicuous tracheae; with tapering points; length (including gills) full grown about 20 mm.

Adults.—Head without postocular spots; wings with 10-14 postnodal cross-veins; width of stigma less than its length, and not remote from the margin in the male. Dorsum of thorax never entirely metallic green, black and blue, and the mesopleural suture without a dark stripe; caudal margin of prothorax of female broken but not trilobed; tibial setae never longer than the intervals between their bases; abdomen with terga 1-6 black, with blue or yellow on the sides, and the female without a spine on sternum of 8.

Adults of this genus have been found in woodlands near shaded pools, and the nymphs have been found in the waters of these pools. The one species of the genus in Connecticut seems to have a retiring habit and is well protected by its natural coloring. The nymphs collected were dredged from the bottom near the shore, in dead leaves and trash, well shaded.

Chromagrion conditum (Hagen)

Bulletin de l'Academie royale . . . de Belgique, 41: 1305: 1876.

Nymph.—Color dark brown.

Head: more than half as long as wide, the caudo-lateral angles projecting strongly; labium when folded extending to the mesocoxae; mental setae 3, sometimes a small fourth; lateral setae 5; proximal segment of the palpus with a distinct hook at the apex of the mesal process; antennae conspicuously annulate, segments 3, 4, and 6 each with a single dark ring, segment 2 dark at base and apex, segment 1 nearly all dark.

Thorax: front and middle femora each with two dark rings; tibiae with a basal ring; wing-cases extending to the fifth or caudal margin of the fourth abdominal segment.

Abdomen: lateral keels without spines; cuticle often dark with white spots; gills (Pl. II, Fig. 2) long and slender, widening gradually to near the apices, then contracted, the margins setose, the setae far apart and increasing in size distad. Color of gills dark brown, except the tips, which are light; indistinct blotches

of darker pigment occur around the margins of the gills; smaller tracheae transparent and indistinct.

Measurements: length (excluding gills), 12-17 mm.; length of abdomen, 8-10 mm.; length of gills, 6-7 mm.; width of gills, 1 mm.; length of median lobe, 2 mm.; width of median lobe, .6-1.6 mm.

Adult, male.—Color blue, black, and yellowish orange.

Head: black or dark brown and blue; mouth parts yellowish; antennae black, the first segment with a blue ring; postclypeus black, the anteclypeus, labrum, mandibles, their trochantins, genae and the front above the clypeus to the level of the antennae, greenish blue; remainder of vertex, occiput and postgenae black.

Thorax: black and blue, yellow on the sides; pronotum largely black, marked with blue on sides; mesepisterna with a broad dorsal stripe which is as wide as the two episterna together adjoining the wing bases, but contracts suddenly cephalad of this, and again about half way to the cephalic margins; katepisterna black and blue; metepisterna and mesepimera blue with black caudal margins, and a brownish spot on the mesepimera behind the katepisterna; postcoxal areas yellowish buff or pollinose, the lateral margins of the intersternum and sometimes the ventral margins of the metepimera dark; metepimera bright yellow, legs mostly black, the femora each with a broad dorsal black stripe which encircles the segment at the apex; tibiae pale buff, with darker stripe on the ventral surface; tarsi black; wings with 10-13 post-nodal cross-veins in the front wing; stigma usually surmounting a single cell.

Abdomen: blue and black, the first tergum with a short basal black spot on the dorsum and cephalic angles; tergum 2 with broad, black dorsal stripe and apical ring; terga 3-7 black with blue basal rings and pale lateral margins; terga 8 and 9 largely blue, with narrow, lateral black margins and a black mesal line on dorsum of each (sometimes very faint or interrupted), the line being about three-fourths the length of the segment and with two small dots, one on each side of the caudal end; terga 10 black except the two small blue spots on the dorsum; anal appendages black, the superiors longer than the inferiors, swollen at their apices and the mesal surfaces densely hairy; inferiors short, pointed at the tips, the dorsal surface flat, Fig. 10, No. 24.

Female.—The blue of the male is replaced by yellow or buff.

Thorax: pronotum curiously modified, the caudal margins not continuous, and the median lobes with a flat, curved, elevated area on each; mesostigmal plates broad, the caudal margins curved, the lateral angles pointed and the caudo-lateral margins elevated.

Abdomen: buff and black, terga 7-10 black above, the sides pale; ovipositor reaching the apex of segment 10.

Measurements: total length, male 34-35, female 33-36 mm.;

length of abdomen, male 27-29, female 27-30 mm.; length of hind wings, male 20-21, female 22 mm.; width of hind wings, male and female, 4 mm.

Connecticut.—Hamden, 4, 18 July, 1920 (P. G.); New London, 6-14 June, 1921 (R. H. H.).

New England.—May 30-July 18.

Genus *Amphiagrion* Selys

Nymph.—Caudo-lateral margin of the head projecting and forming a decided angle; labium with mental setae; abdomen without spinulose lateral keels, the gills less than half as broad as long, and without a long tapering point; length when grown including gills about 16-20 mm.

Adult.—Head without postocular spots; front wings with about 9 postnodals and M_2 arising between the third and fifth of these; stigma of male not remote from the margin; dorsum of thorax brown, the mesopleural suture not covered with black; caudal margin of female prothorax entire; tibial setae of middle and hind tibiae about equal to the intervals between them; abdomen with terga 1-6 reddish or brown, the female with a spine on apex of the eighth sternum.

Adults of this genus have been found near small streams and it is probable that the nymphs live in such streams rather than in ponds or lakes. Not much, however, is known of the habits of the nymphs.

Amphiagrion saucium (Burmeister)

Handbuch der Entomologie, 2: 819: 1839.

Nymph.—Color dark brown.

Head: pentagonal and with strongly projecting caudo-lateral angles; labium broad, and extending to the metacoxae, the median lobe with 3 or 4 mental setae; 6 lateral on the palpi.

Thorax: legs uniform brown and without darker rings; wing-cases extending to the fourth or fifth abdominal segment.

Abdomen: lateral keels absent or feebly developed and without spinules; ovipositor of female nearly reaching the apex of the tenth segment in full-grown nymphs; gills transparent ovate-lanceolate, the tips gradually narrowed to a sharp point; margins of the gills setose from proximal to distal end, the setae placed close together and increasing in length towards the apices; tracheal trunks sometimes dividing and forming a number of large branches near the proximal fourth of the gill.

Measurements: length, 11-14 mm.; length of abdomen, 7-10 mm.; length of gills, 4.5 mm.; width of gills, 1.5 mm.; length of median lobe, 1.75-2.0 mm.; width of median lobe, 1.25-1.5 mm.

Adult, male.—Color, very dark brown and deep orange-red.

Head: dark brown or black to reddish above, mouth parts and surrounding regions brown or buff; antennae buff or brown.

Thorax: dark brown above; color sometimes brick red or almost black; no definite stripes or spots present; legs brown; tibial spines but little longer than the intervals between them; wings with about nine postnodal cross-veins in the front wing; M_2 arising between the fourth and sixth postnodal in the front wing and between third and fifth in the hind; stigma surmounting less than one cell, the caudal margin usually shorter than the cephalic.

Abdomen: red and black or nearly black; segments 1-6 red, 7-10 nearly black on the dorsum with paler basal rings and pale on sides and below; anal appendages (Fig. 12, Nos. 14 and 15) consisting of flat depressed superiors; inferiors longer, acute, subconical, the tips directed dorso-mesad. Apical margin of the tenth segment with a deep rounded pit on the dorsum.

Female.—Color usually lighter than the male.

Thorax: not dark above as in the male.

Abdomen: terga 1-4 reddish; 5-6 mostly red, sometimes with black spots on each near the caudal fourth; terga 7-9 each with two dorsal black stripes which may, however, be fused; tergum 10 entirely pale; eighth sternum with a long spine, ovipositor brown.

Measurements: total length, male 23-26, female 24-26 mm.; length of abdomen, male 19-21, female 19-21 mm.; length of hind wings, male 13-16, female 15-16 mm.; width of hind wings, male 3-3.5, female 3.5 mm.

Connecticut.—New Haven, 25, 26 May, 1904 (H. L. V.), 20 July, 1904 (B. H. W.), 27 June, 1905 (W. E. B.); New London, 8, 9 June, 1921 (R. H. H.); Middletown, 18 June, 1904 (W. E. B.), 14 July, 1921 (P. G.).

New England.—May 25-July 29.

Genus *Nehallenia* Selys

Nymphs.—Caudo-lateral margins of the head rounded; labium with mental setae; abdomen with spinulose lateral keels, the gills with moderately sharp points, the tracheae more numerous at the widest part of the gill; total length including gills, about 15 mm. when grown.

Adults.—Head without postocular spots; wings with about 11 postnodals; and M_2 arising between the third and fifth postnodal cross-vein in the front wing; stigma of male not remote from the margin; dorsum of thorax entirely metallic green, the caudal margin of the female prothorax bi- or trilobed or entire; tibial setae mostly shorter than the intervals between their bases; mesopleural suture covered with green; abdomen with terga 1-6 green and the female without a ventral spine on 8.

The adults of this genus may be found usually near small ponds or sphagnum bogs. The nymphs are not commonly collected but have been taken in a small open pond at Mt. Carmel.

For literature dealing with adults of this genus, see: Calvert, P. P. Entomological News, 24: 310-316: 1913; also pages 373-4.

Key to Species

Adults

Males and Females

1. Caudal margin of female pronotum entire; superior anal appendages of the male longer than the inferiors **integricollis**
Caudal margin of female pronotum bi- or trilobed; superior anal appendages of the male shorter than the inferiors 2
2. Terga 9 and 10 of the abdomen, and most of 8 entirely blue in the male; pronotum of female bilobed **gracilis**
Terga 8 and 9 with considerable black on dorsum and sides; pronotum of female trilobed **irene**

In addition to the species mentioned, Miss Butler has described a species, *Nehallenia carlotta*, from Saranac Inn, New York, which is said to differ from *gracilis* in the shape of the anal appendages. (Can. Ent. 46; p. 346 figs. e, f; 1914.) These, according to the figures, are slightly more pointed than those of *gracilis*.

Nehallenia integricollis Calvert

Entomological News 24: 312, 373-4: 1913.

Nymph.—Unknown.

Adult, male.—Predominating color dark green or bronze.

Head: labrum about half blue; postclypeus black, anteclypeus blue; blue on sides of head below the eyes and a pale transverse stripe above clypeus, the pale color below the eyes extending onto the postgenae in a broad vertical stripe; second antennal segment with a pale ring at middle.

Thorax: greenish bronze above, blue or pale on sides and below; a straight line from base of the hind wings to the middle of the katapisternum of the mesothorax marks lateral boundary of the dark color; wings with two antenodal cells, or one antenodal cross-vein.

Abdomen: bronzy green, pale blue or orange color along the lateral margins and below; segments 9 and 10 pale blue, 9 with two dark triangles at base above (sometimes confluent), 10 sometimes with dark transverse stripe; inferiors a little longer than the superiors with two teeth-like projections and one tooth on the superior.

Female.—Similar in color to the male.

Thorax: hind margin of the pronotum (Fig. 11, No. 18) entire, being neither bi- nor trilobed.

Abdomen: segment 10 blue, 9 black with blue triangle on dorso-meson, the sides pale.

Measurements: total length, male 22.5, female 24-28 mm.; length of abdomen, male 18.4, female 24.5 mm.; length of hind wings, male 12.5, female 13.5-16.5 mm.

Nehallenia gracilis Morse

Psyche 7: 274: 1895.

Nymph.—The nymphs of this species are said by Walker (Canadian Entomologist 45: 161-2: 1913) to lack the dark spots on the gills, present in *irene* and to have fewer spines on the rear of the head (4-6 compared with 12 or more in *irene*).

Measurements: total length, 11 to 13 mm.; length of gills, 3-3.7 mm.; length of hind wing-cases, 2.2-2.7 mm.; length of hind femora, 2-2.3 mm.

Adult, male.—Color green and blue.

Head: greenish bronze above; pale blue postocular spots apparently formed by continuations of the postocellar stripe; face below the compound eyes also blue; second antennal segment with pale ring at middle.

Thoracic dorsum metallic green, the green color extending beyond the mesopleural suture; wings with three antenodal cells or two antenodal cross-veins; caudal margin of the pronotum entire.

Abdominal segment 8 blue, except a very narrow transverse basal band, 9 and 10 all blue; superior anal appendages nearly as long as the inferiors, the latter each with a sharp tooth at the caudo-dorsal angles when viewed in profile.

Female.—Pronotum with the caudal margin bilobed, the median incision with a small erect process (Fig. 11, No. 19); abdomen with a large triangular spot on segment 9 and all of segment 10 blue; spot on 9 sometimes produced to base and the dorsum of 8 nearly or entirely blue, with a black band on each side in the cephalic half of the segment.

Measurements: length of abdomen, male 20-22, female 20-22 mm.; length of hind wings, male 13-14.5, female 14-15 mm.

Reported from Canada, Massachusetts, New Jersey and New York.

New England.—June 19-July 19.

Nehallenia irene Hagen

Synopsis of the Neuroptera of North America, 74: 1861.

Nymph.—Color brown or green.

Head: caudo-lateral margins with few spines; second antennal segment longer than the first, the second segment and the proximal third of number 3, dark brown; remainder of the antennae lighter; labium extending nearly to the mesocoxae; each side of the median lobe with a large mental seta and smaller one along-side; lateral setae six.

Thorax: femora and tibiae with sparsely placed rows of setae, the preapical brown femoral rings distinct; wing-cases extending nearly to the apex of fourth abdominal segment, in some to the middle of 5.

Abdomen: lateral keels of segments 6-8, with not more than 6-7 spinules, that of the first segment usually without any; cuticle of the abdomen with small whitish spots on a darker background; gills broader beyond the middle, the lateral gills with 10-12 black spots on the margins and sometimes a distinct arcuate cross-band beyond the middle; tracheal branches more numerous beyond the middle; marginal spines of lateral gills well separated, the proximal ventral row of heavy spines extending beyond the middle of the lateral gills; ovipositor usually extending beyond the apex of the tenth segment.

Measurements: length, 10-11 mm.; length of abdomen, 7-8 mm.; length of gills, 4-4.5 mm.; width of gills, 1 mm.; length of median lobe, 1.5-1.7 mm.

Adult, male.—Color bright metallic green, yellow, and sometimes pale blue.

Head: metallic green, pale below; mouth-parts, ventral half or two-thirds of labrum, genae and front to clypeo-frontal suture, yellow; dorsal half or third of labrum usually black; postclypeus black or green; remainder of head including vertex, occiput, and postgenae mostly metallic green; second segment of the antennae with a pale ring at middle.

Thorax: pronotum green, propleura pale; mesothorax with black dorsal carina; episterna green except the ventral third of the katepisterna and a pale line on its dorsal border; mesepimera mostly green, their cephalic shoulders pale; metapleura pale yellow, except for the caudo-dorsal angles of the episterna and a small black spot on the metapleural suture near the wing-bases; postcoxal areas yellow; legs striped but mostly pale yellow, the femora all with a distinct dorsal vitta, the tibiae also with a narrower stripe above but not usually extending the full length of the segment; tarsi and claws pale except at their apices; wings with 9-11 postnodal cross-veins in the front wing, M_2 arising usually between the fourth and fifth of these in the front wing and between the third and fourth in the hind.

Abdomen: metallic green above the lateral margins of the terga, pale yellow or blue; dorsum of 1-8 green above, usually blue on sides of 2 and 8, the remaining terga usually with yellow margins, terga 9 and 10 blue with green basal, somewhat triangular areas on each side of the meson; anal appendages mostly pale, the superiors small, the inferiors toothed at their apices.

Female.—Color metallic green or bronze and yellow.

Thorax: pronotum (Fig. 11, No. 17) differing from the male in having the caudal lobe emarginate on each side of the meson, the piece being trilobed in consequence; the mesostigmal plates have the mesal margins strongly elevated.

Abdomen: ninth tergum green above with an apical blue or brown triangle and blue lateral margins; tergum 10 blue, with

two small green triangles at the base; ovipositor including styli extending beyond the apices of anal appendages.

Measurements: total length, male 25-27, female 26-29 mm.; length of abdomen, male 21, female 21-22 mm.; length of hind wings, male 13.5-15, female 14-17 mm.; width of hind wing, male 3-4, female 3-4 mm.

Connecticut.—West Haven, 29 June, 1905 (H. L. V.); Stratford, 9 July, 1920; Hamden, 28 June, 4 July, 1920; New Haven, 3 July, 1920 (P. G.); New London, 17 June, 1921 (R. H. H.); Litchfield, 5 July, 1911 (L. B. W.).

New England.—May 28-August 23.

Genus *Teleallagma* Kennedy

Adults.—Postocular spots present; postnodal cross-veins 11-12 in the front wing; M_2 arising between the fifth and sixth of these; stigma of the male not remote from the margin; Cu_2 terminating in the hind margin of the front wing between the nodus and origin of M_2 ; dorsum of thorax not metallic green, but brown or blue; tibial setae shorter than the distances between them; mesopleural suture marked with black; abdomen very slender with terga 1-5 never entirely red or yellow, but blue or green on sides, with black dorsal stripes; vulvar spine present in the female.

The only representative of this genus in the United States was placed doubtfully in *Telagrion* by Calvert (Ent. News 14, 36-39: 1903). Since then Kennedy (Ohio Journal of Science xxi: 87: 1920), who has studied the genera of Zygoptera critically, erected the genus *Teleallagma* for this species and states his reasons for the change in correspondence; namely, that the female of *Telagrion* Selys lacks the vulvar spine present in *T. daeckii*, which is enough in itself to separate *daeckii* from this genus. *Daeckii* is furthermore a close relative of the *Enallagmas* both in anal and accessory appendages, but differs enough in wing venation and general form to stand under a different genus. Thus being excluded from both *Enallagma* and *Telagrion* a new genus is the only alternative, hence the name *Teleallagma*. All this information together with the uncertainty with which Calvert placed the species in *Telagrion* has led to the adoption of the new name.

Teleallagma daeckii (Calvert)

Entomological News, 14: 36-39: 1903.

Adult, male (Fig. 42, Nos. 1, 3, 4 and 5).—Color pale blue and black.

Head: mostly blue with black as follows: mid-dorsal spot on labrum; postclypeus with a spot each side sometimes connected and a basal line; short narrow stripe in front of median ocellus and another zigzag stripe behind it; a spot behind base of each

antenna; mesal margins of lateral ocelli, and narrow margins of the large postocular spots.

Thorax: pale blue; median pronotal lobes with a curved black spot on each side, and another short dash on each side below it, extending onto the sides of the prothorax; dorsal carina of mesothorax with a very narrow dark line on each side, hardly wider than the carina itself; mesopleural suture with a thin line of dark pigment, much widened at middle and at either end; dorsal and caudal margins of katepisternum dark; hind tibia with six spines below on the outer side, and a dorsal dark stripe from base to apex; wings as in Fig. 42.

Abdomen: blue or greenish yellow with narrow dorsal dark stripes on terga 1-7, that on 7 narrowed to a line, the caudal fourth or fifth of the segment mostly blue, segments 8, 9, and 10 entirely blue. Superior anal appendages (Fig. 42, Nos. 3, 4) with a rounded ventral lobe, and a truncate distal projection, the inferiors slightly longer.

Female.—Blue of male replaced by brown or greenish yellow, that of the head by brown. Color of abdomen differs from the male in having dorsal stripes on segments 1-8 inclusive, segments 9-10 blue.

Measurements: total length, male 41, female 35 mm.; length of abdomen, male 35, female 29 mm.; length of hind wings, male 22, female 20 mm.

Described from a pair obtained through the courtesy of Mr. Wm. T. Davis, collected at Southern Pines, North Carolina, June 9, 1920. The species has not yet been found in Connecticut, but occurs in New Jersey and southward as far as the Carolinas.

Genus *Enallagma* Charpentier

Nymphs.—Head without projecting caudo-lateral margins, the latter rounded instead; labium with mental setae; abdomen with spinulose lateral keels; gills less than half as broad as long, with or without cuticular pigment, but usually with conspicuous tracheae, and generally with blunt points, not, however, as rounded as those of some *Argias*; length when grown about 20 mm.

Adults.—Postocular spots present; wings usually with less than 12 postnodal cross-veins, and M_2 arising between the 4th and 6th in the front wings; width of stigma nearly equal its length or much less; dorsum of thorax never entirely metallic green, usually brown or black with lighter-colored stripes; caudal margin of the female pronotum never trilobed; the tibial setae never twice as long as the intervals between their bases (scales or flattened setae excepted); mesopleural suture usually with a black or dark brown stripe; abdomen with terga 1-6 never entirely red or yellow, and the female with a spine on sternum of 8.

A comparatively large genus represented in New England by about 18 species.

For literature on adults, see:

Calvert, P. P. Transactions of the American Entomological Society, XLV: 373-392: 1919, Plate XXXIII (limited to *vesperum* group).

——— *Biologia Centrali Americana*, 1902, 103: 379, etc.

See also publications of Calvert, Garman, Howe, Kellicott, and Needham.

Synopses and treatises on the nymphs have been published by:

Garman, P. Bulletin of the Illinois State Laboratory of Natural History, XII: 517-559: 1917.

Howe, R. H. Memoir of the Thoreau Museum of Natural History, II: 110-113: 1921.

Needham, J. G. New York State Museum Bulletin 68: 250-258: 1903.

In general the *Enallagmas* of New England may be grouped together in several divisions as follows:

1. The *vesperum-signatum* group, containing *signatum*, *pictum* and *vesperum*. Probably the most distinct of all the groups and characterized by the frequent occurrence of yellow or orange pigment in the adult, by the peculiar shape of the mesostigmal lamina, and the structure of the nymphal abdomen and gills (p. 61).
2. The *civile-carunculatum* group, containing *civile*, *carunculatum*, *doubledayi* and possibly also *calverti* and *cyathigerum*, although the latter may belong to another division (p. 65).
3. The *hageni-ebrium* group, to which *recurvatum*, *laterale* and probably *geminatum* and *minusculum* also belong (p. 71).
4. The *exsulans-traviatum* group, composed of *exsulans*, *traviatum* and *divagans* and characterized by the color pattern of the thorax, which shows a modified or divided stripe over the mesopleural suture, and the peculiar shape and pigmentation of the gills of the nymph (p. 79).
5. *Durum* apparently distinct from all other groups at least in the adult.
6. *Aspersum*, possibly belonging to one of the other groups above but fairly distinct in the adult stage (p. 84).

The different groups of *Enallagmas* are fairly distinct in habits, and continued study of this phase of the question will reveal many more points of difference than can be listed here. Thus group 1 is, in general, a small clear-lake-loving group. Group 2 inhabits for the most part small ponds and weedy pools, while group 3 is also a lake-pond group. The *exsulans-traviatum* group are frequenters of small streams, usually slow flowing, but are sometimes encountered in other localities. The only specimens of group 5 that have been collected in Connecticut have been found near brackish water, and it is probable that the species requires such an environment. The eggs of most species are laid on the stems of plants beneath the surface, but this habit is not universal as indicated by the quotation from Woods on page 14.

Key to Species

Nymphs⁴

- | | |
|--|---|
| 1. Gills without pigment except in tracheae and sometimes a trace along the axes | 2 |
| Gills with pigment other than in tracheae, usually in cross-bands | 7 |

⁴ This key is based primarily on the characters of the final stages with well-developed wing-cases. The species *hageni*, *ebrium*, *geminatum*, *civile*, and *doubledayi* are very closely related and this part of the key should be used with caution.

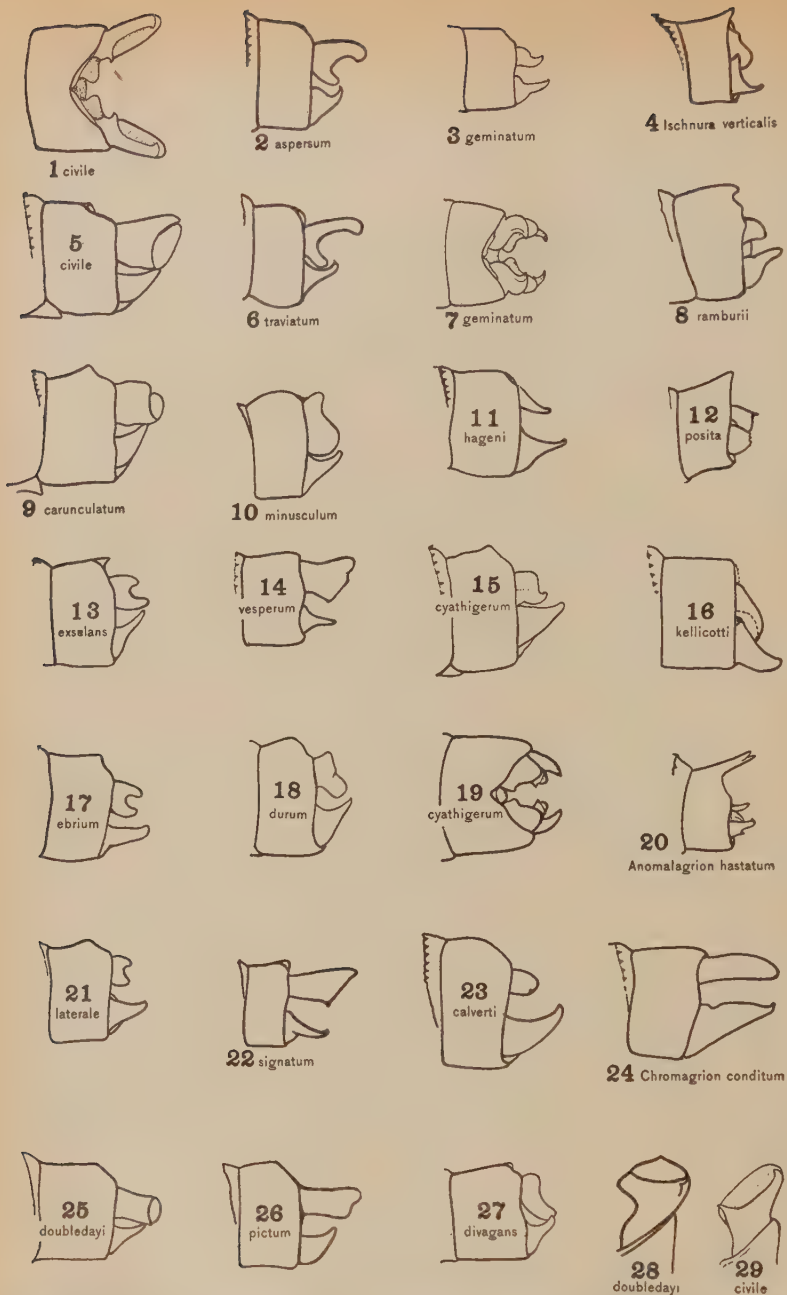


FIG. 10. Anal appendages of *Enallagma*, *Ischnura*, *Chromagrion* and *Anomalagrion*. 1. *Enallagma civile*, dorsal view. 2. *E. aspersum*. 3. *E. geminatum*. 4. *Ischnura verticalis*. 5. *Enallagma civile*. 6. *E. traviatum*. 7. *E. geminatum*, dorsal view. 8. *Ischnura ramburii*. 9. *E. carunculatum*. 10. *E. minusculum*. 11. *E. hageni*. 12. *Ischnura posita*. 13. *Enallagma exsulans*. 14. *E. vesperum*. 15. *E. cyathigerum*. 16. *Ischnura kellicotti*. 17. *Enallagma ebrium*. 18. *E. durum*. 19. *E. cyathigerum*, dorsal view. 20. *Anomalagrion hastatum*. 21. *Enallagma laterale*. 22. *E. signatum*. 23. *E. calverti*. 24. *Chromagrion conditum*. 25. *Enallagma doubledayi*. 26. *E. pictum*. 27. *E. divagans*. 28. *E. doubledayi*, right superior appendage from the left and above. 29. Same of *E. civile*.

2. Tracheae of gills in alga-like patches (Pl. I, Figs. 8 and 9) } *hageni*
Tracheae of gills not in alga-like patches 3 } *ebrium*
3. Lateral keels of the first abdominal segment with 0 to 2 spines;
axes of the gills clear 4
Lateral keels of the first abdominal segment with 2 to 4 spines;
axes of the gills more or less clouded *carunculatum*
4. Dorsal marginal spines of the median gill usually less than 20 in
full-grown nymphs; all of the third antennal segment dark
brown; gills rarely more than 4.5 mm. in length (Pl. I, Fig. 7) } *geminatum*⁵
Dorsal marginal spines of the median gill more than 20 in full-
grown nymphs; only the proximal third of the third antennal
segment dark brown; gills 5.5 to 6 mm. in length 5
5. Marginal spines of both lateral and median gills not reaching the
middle of the gill *civile*
Marginal spines of both lateral and median gills reaching much
beyond the middle 6
6. Tracheae of the gills numerous (Pl. I, Fig. 11) *durum*
Tracheae few (Pl. I, Fig. 12) *doubledayi*
7. Tracheal branches of the gills in alga-like patches; caudo-lateral
margins of the head behind the eyes greater than half the distance
between the antennae 8
Tracheal branches of the gills not in alga-like patches; caudo-
lateral margins of the head behind the eyes less than half the
distance between the antennae 9
8. Dark portion of the base of the gills less than half their length
(Pl. II, Fig. 4) *traviatum*
Dark portion of the base of the gills extending more than half
the length of the gill (Pl. II, Fig. 9) *exsulans*
9. Spines of the lateral abdominal keels not grouped conspicuously
near the caudal ends of the keels on each segment; gills as in
Pl. I, Fig. 10 } *cyathigerum*
..... } *calverti*
- Spines of the lateral abdominal keels grouped conspicuously near
the caudal ends of the keels on each segment; gills as in Pl. II,
Figs. 5, 10 10
10. Median gill with a bunch of heavy spines on the dorsal margin
proximal of the first transverse cross-band; distal cross-bands
of about the same degree of blackness as the proximal ones;
median gills not expanded greatly distad of the first cross-band
(Pl. II, Fig. 5) *signatum*
Median gills without a bunch of spines on the dorsal margin proxi-
mal of the first transverse cross-band, sometimes with a few
weak, well-distributed spines; distal cross-bands much lighter
in color than the proximal ones, and sometimes wanting; median
gill usually well expanded distad of the first transverse cross-
band (Pl. II, Fig. 10) *vesperum*

Adults, Males

1. Three cross-veins in both wings between M_4 and Cu_1 between the
subnodus and the quadrangle *durum*
Two cross-veins in both wings between M_4 and Cu_1 between the
subnodus and the quadrangle 2

⁵ An exuviae, possibly *minusculum*, received from Dr. Calvert differs from *geminatum* in having no spines on the keels of segments 1 to 3. This was referred by Dr. Calvert to *vesperum* but is doubtfully that species. (Trans. Am. Ent. Soc. xlv, 384-385; 1919.)

2. Dorsum of the second abdominal segment with black spot occupying at most half the segment, usually less 3
 Dorsum of the second abdominal segment with black spot occupying more than half the length of the segment, usually as long as the segment 13
3. Caudal half of the seventh abdominal tergum blue **aspersum** 4
 Caudal half of the seventh abdominal tergum black 4
4. Dorsum of the fourth and fifth abdominal terga more than half black 5
 Dorsum of the fourth and fifth abdominal terga less than half black 7
5. M_2 of the hind wing arising between the third and fourth postnodal cross-vein 6
 M_2 of the hind wing arising beyond the fourth postnodal cross-vein **carunculatum**
6. Superior anal appendages with a large rounded ventral lobe (Fig. 10, No. 10) **minusculum**
 Superior anal appendages without a rounded ventral lobe; similar to *hageni* but the tips upturned **recurvatum**
7. Superior anal appendages bifurcate, their arms separated by an obtusely rounded notch 8
 Superior anal appendages not bifurcate, sometimes notched, the notch acute 9
8. Tergum 8 blue with black stripe on each side **laterale**
 Tergum 8 entirely blue **ebrium**
9. Inferior anal appendages longer than the superiors 10
 Inferior anal appendages shorter than the superiors 12
10. M_2 usually arising between the third and fourth postnodal cross-vein in the hind wings; anal appendages as in Fig. 10, No. 11 **hageni**
 M_2 arising between the fourth and fifth postnodal cross-vein in the hind wings 11
11. Superior anal appendages blunt; lateral profile as shown in Fig. 10, No. 23 **calverti**
 Superior anal appendages acute; lateral profile as shown in Fig. 10, No. 15 **cyathigerum**
12. Superior anal appendages with the apical tubercle or lobe projecting noticeably beyond the dorso-caudal angles when viewed from the side (Fig. 10, Nos. 25, 28) **doubledayi**
 Superior anal appendages with the apical tubercles not projecting noticeably beyond the dorso-caudal angles when viewed from the side (Fig. 10, Nos. 1, 5, 29) **civile**
13. Second antennal segment pale except the distal third, which is frequently dark brown 14
 Second antennal segment entirely dark brown or black 16
14. Dark stripe of the mesopleural suture paler in color than the dorsal stripe covering the carina, or reduced to a line; anal appendages as in Fig. 10, No. 14 **vesperum**
 Dark stripe of the mesopleural suture not paler in color than the dorsal stripe covering the carina 15
15. Superior anal appendages without a ventral tooth (Fig. 10, No. 26); dorsum of abdominal segment 9 black **pictum**
 Superior anal appendages with a ventral tooth (Fig. 10, No. 22); dorsum of abdominal segment 9 pale **signatum**
16. Front with blue color extending to the median ocellus; postocular spots large, each forming an equilateral triangle in shape; black stripe of the mesopleural suture narrow, indistinct or wanting **traviatum**
 Front with blue or pale color not extending dorsad to the median

- ocellus, not dorsad of the antennal fossae; postocular spots each forming a wedge-shaped figure or comma; black stripe of the mesopleural suture distinct, never wanting 17
17. Second abdominal tergum with a dark longitudinal stripe just above the lateral margins on each side **geminatum**
Second abdominal tergum without a dark longitudinal stripe 18
18. Caudal half of tergum 7 blue; dorsal arm of superior much longer than ventral arm in lateral profile **aspersum**
Caudal half of tergum 7 black; dorsal arm of superior shorter than ventral arm 19
19. Dorsum of tergum 8 black from base to apex; anal appendages as in Fig. 10, No. 13 **exsulans**
Dorsum of tergum 8 with only a black spot at base; anal appendages as in Fig. 10, No. 27 **divagans**

Females^a

1. Three cross-veins present in the wings between M_4 and Cu_1 and between the subnodus and quadrangle **durum**
Only two cross-veins between subnodus and quadrangle 2
2. Prominent pits present in the pronotum, one on each of median lobes 3
No prominent pits present in the pronotum 8
3. Antennal segment 2 pale at base; mesostigmal lamina reaching the mesopleural suture, the entire lateral end in contact with the katapisternum 4
Antennal segment 2 not pale at base; lateral end of the mesostigmal lamina touching the mesopleural suture at a single point only 6
4. Black stripe of the mesopleural suture reduced in width to a line **vesperum**
Black stripe of the mesopleural suture not reduced in width to a line 5
5. Black stripe of the mesopleural suture touching the ventro-lateral end of the mesostigmal lamina (Fig. 11, No. 2) **signatum**
Black stripe of the mesopleural suture not touching the ventro-lateral end of the mesostigmal lamina **pictum**
6. Abdominal tergum 8 with a large pale spot on each side; black stripe present just above the ventro-lateral margin of the second tergum (sometimes brown or wanting) **geminatum**
Abdominal tergum 8 without a large pale spot on each side; without stripe just above ventro-lateral margin of the second tergum 7
7. Mesostigmal lamina narrowed at middle; caudal and lateral margins not elevated (Fig. 11, No. 5) **ebrium**
Mesostigmal lamina widened at middle; caudal and lateral margins elevated (Fig. 11, No. 6) **hageni**
8. Pronotum with mound-like elevation on the caudal lobe, the caudal lamina conspicuously thickened at the middle; stripe of the mesopleural suture reduced in width, and either divided by brown color over the suture or with brown margins 9
Pronotum without a mound-like elevation on the caudal lobe; stripe of the mesopleural suture uniform black and not reduced in width 11
9. Pale color of the face extending dorsad above the antennae; black of the eighth abdominal segment reduced to a small basal dash or stripe **traviatum**
Pale color of the face not extending dorsad above the antennae; black of the eighth never reduced to a small basal dash 10

^a Females of *recurvatum* and *laterale* not available.

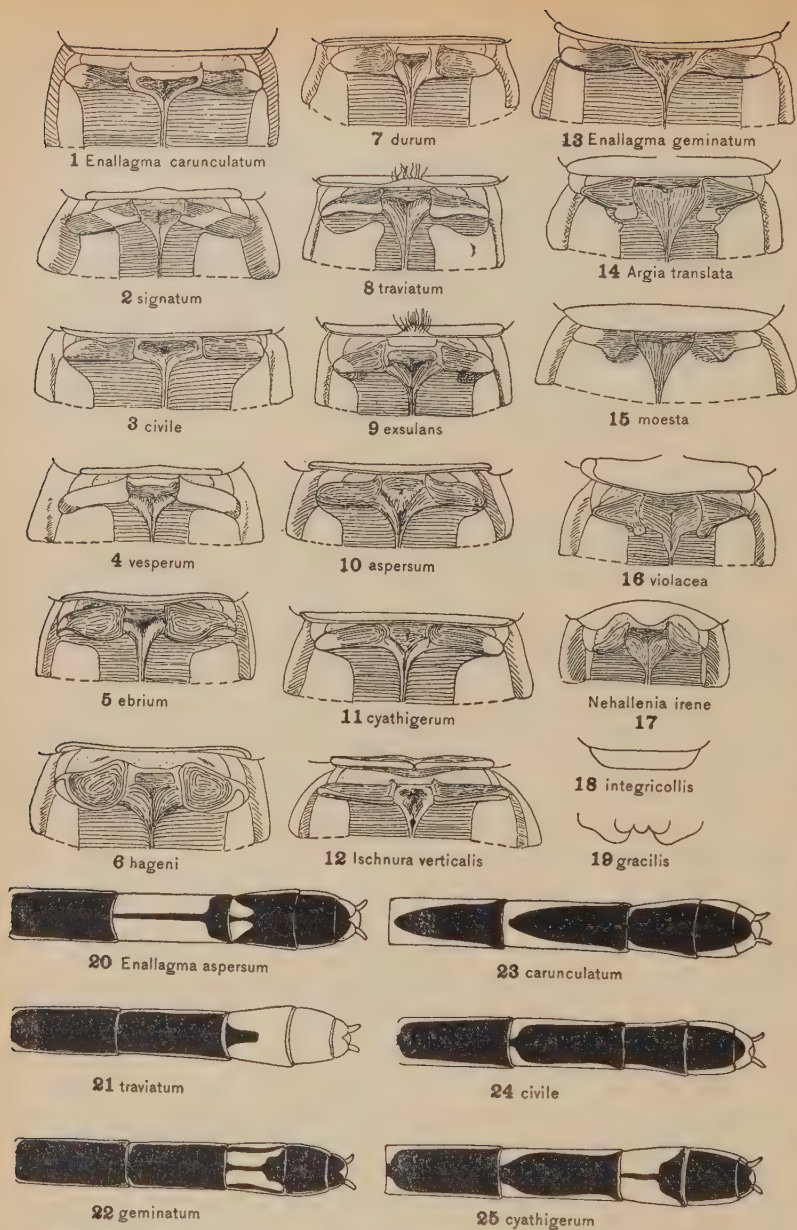


FIG. 11. Portion of the thorax showing caudal margin of pronotum, mesostigmal plates and mesothorax of *Enallagma*, *Ischnura*, *Argia* and *Nehallenia*, and abdominal color pattern of females of *Enallagma*. 1. *Enallagma carunculatum*. 2. *E. signatum*. 3. *E. civile*. 4. *E. vesperum*. 5. *E. ebrium*. 6. *E. hageni*. 7. *E. durum*. 8. *E. triviatum*. 9. *E. exsulans*. 10. *E. aspersum*. 11. *E. cyathigerum*. 12. *Ischnura verticalis*. 13. *Enallagma geminatum*. 14. *Argia translata*. 15. *A. moesta*. 16. *A. violacea*. 17. *Nehallenia irene*. 18. *N. integricollis*, hind margin of the pronotum. 19. Same of *N. gracilis*. 20. *Enallagma aspersum*, color pattern of the last five abdominal segments. 21. *E. triviatum*. 22. *E. geminatum*. 23. *E. carunculatum*. 24. *E. civile*. 25. *E. cyathigerum*.

- 10.⁷ Pronotum without two approximate median spots on the median lobe; tergum 8 with two pale blue spots on the caudal margin; stripe of the mesopleural suture not usually divided by brown as far forward as the katepisternum **divagans**
 Pronotum with two small pale spots on the dorso-meson; tergum 8 with dorsum entirely black; stripe of the mesopleural suture usually divided by brown as far forward as the katepisternum **exsulans**
11. Eighth tergum, either largely blue or with a large blue or pale spot on each side 12
 Eighth tergum neither largely blue nor with a large blue or pale spot on each side 14
12. Seventh abdominal tergum mostly pale blue, the black confined to a small spot on caudal margin and mid-dorsal line **aspersum**
 Seventh abdominal tergum black above, pale on sides, the black not confined to a small spot and mid-dorsal line 13
13. Cephalo-mesal angles of mesostigmal lamina hollowed out (Fig. 11, No. 11) **cyathigerum**
 Cephalo-mesal angles of mesostigmal lamina not hollowed out **calverti**
14. Adults of small size, abdomen not over 20 mm.; pronotum entirely black; M_2 arising proximad of the 4th postnodal cross-vein in the hind wings **minusculum**
 Adults of larger size, abdomen more than 20 mm.; pronotum not entirely black; M_2 distad of the 4th postnodal cross-vein in the hind wing 15
15. Mesostigmal lamina each with a diagonal ridge; black of abdominal segments 4-7 considerably reduced near the front margin, and often not reaching the cephalic border **carunculatum**
 Mesostigmal lamina without diagonal ridges; black of abdominal segments 4-7 not greatly reduced near the front margin, and usually reaching the cephalic border **doubledayi**; **civile**

Group I VESPERUM-SIGNATUM Group

Enallagma pictum Morse

Psyche, 7: 307: 1895.

Nymph.—Unknown.

Adult, male.—Color reddish brown or yellow and black.

Head: reddish brown or yellow and black; first two antennal segments pale; postocular spots narrow, the lateral ends hardly widened, the mesal ends connected with the postocellar stripe.

Thorax: yellow or orange and black; legs pale; wings with 10 to 11 postnodal cross-veins in the front wing and about 10 in the hind wing; M_2 arising near the fifth postnodal cross-vein in the front wing and between the fourth and fifth in the hind.

Abdomen: yellow or orange and black; black as follows: dorsum of 1 and 2, the cephalic half of the dorsal stripe of this segment considerably narrowed; dorsum of terga 3 to 10 except narrow basal rings; anal appendages as in Fig. 10, No. 26, and differing from *signatum* in having the superiors shorter, more rounded at the tips, and without the ventral tooth of *signatum*.

⁷ This separation of *divagans* and *exsulans* is not entirely reliable and the females are so closely related that they can not be easily determined. *Divagans* is, however, a rare species in Connecticut.

Female.—In general similar to the male in color; black stripe of the mesopleural suture touching the lateral ends of the mesostigmal plates; mesepisternal tubercles present at margins of the mesostigmal plates; pale stripe of the mesepisternum narrower than the black stripe covering the mesopleural suture.

Measurements: total length, male 30-31 mm.; length of abdomen, male 24-26, female 25-26 mm.; length of hind wings, male 15-17, female 17-18 mm.

New England.—July 27-August 23.

***Enallagma signatum* (Hagen)**

Synopsis of the Neuroptera of North America, 84: 1861.

Nymph.—Color buff or greenish.

Head: elliptical in outline, caudo-lateral angles not projecting; first 2 segments of the antennae dark in color, nearly equal in length, the second slightly shorter, the third longest, the remaining ones decreasing successively in length; labium extending caudad of procoxae, with 3 mental setae and 5 laterals.

Thorax: legs light in color except a dark ring on each femur; tips of third tarsal segments dark; metathoracic wing-cases extending nearly to the fifth abdominal segment.

Abdomen: segments of abdomen appear to have a greater transverse diameter near the apical fourth on account of the projecting lateral keels; the keels are well developed and setose, the heavier setae being grouped mainly at one point near the apex of each keel; dorsum of segments 4-8 with short heavy spines at apices, terga 9 and 10 with more spines, usually extending onto the venter; sterna 2, 3 and 4 with a cluster of small thick spines on the apical third, and the venter with a black line from basal segment to segment 9; gills (Pl. II, Fig. 5) lanceolate, the dorso-marginal spines of the median gill usually much heavier, just proximad of the first transverse band of pigment; beyond the ventral marginal row of setae, the margins of the lateral gills are emarginate; the pigmentation of the gills consists of 3-5 broad black cross-bands and a broad axial band from bases to the apices; ovipositor of female extending to the middle of abdominal segment 10.

Measurements: length, 16-18 mm.; length of abdomen, 10.5-12.5 mm.; length of gills, 5.5-6 mm.; width of gills, 1.6 mm.; length of metathoracic wing-cases, 4 mm.; length of median lobe, 2 mm.; width, .5-1.8 mm.

Adult, male.—Color pale blue or orange and black.

Head: blue or orange and black; first two segments of antennae pale, at least much paler than the distal ones, the second segment darker at the tip; postclypeus black, sometimes with two median pale spots, one on each side of the meson; anteclypeus pale;

labrum pale, the dorsal margin with a mesal black spot and two lateral, or with a transverse stripe of black including the three spots; pale transverse area above the clypeus extending slightly dorsad of the antennae, orange or blue; remainder of the front and vertex black; postocular spots large, cuneiform, and yellow or blue; postgenae and the occiput largely yellow.

Thorax: orange or blue and black; pronotum black, the cephalic lobe, a subcircular spot on each median lobe, and the caudal lobe blue or yellow; the spots on the median lobes are variable, being frequently subcircular with an emargination on one side; in younger individuals there are also two smaller spots mesad of the large spots on each mesal lobe; proepimera blue or yellow, darker above; mesopleural suture also with a broad black stripe which is widest caudad of the katepisternum and extends cephalad and covers the dorsal third of that sclerite; the remainder of the thorax is pale blue or orange, buff-colored below; legs usually buff, the femora each with an indefinite dorsal brown line and row of spots, the tibiae with a faint dorsal line or row of dashes; tarsi pale, darker at apices; wings with 9-11 postnodal cross-veins in the front wing; M_2 usually arising near the fifth postnodal vein in the front wing, between the fourth and fifth, or third and fourth in the hind, usually near the fourth.

Abdomen: orange or blue and black; dorsum of terga 1-8 inclusive, black, except interrupted basal rings on 3-7, lateral surfaces of 1 and 2, and the lateral margins of 3-8; all of tergum 9 and the lateral surfaces of the tenth orange or blue, the dorsum of 10 being black; anal appendages dark brown (Fig. 10, No. 22) the superiors longer than the inferiors and blunt at the apices, the lateral surfaces convex, the mesal surfaces somewhat concave, tips dark; inferiors about half as long as the superiors, subconical, the tips black and directed mesad.

Female.—Color pale blue or orange, sometimes greenish and black.

Head: similar to that of the male.

Thorax: similar to the male; the orange females are, however, less frequent; mesostigmal plates (Fig. 11, No. 2) long, the lateral margins rounded, and depressed, and a pale diagonal stripe across the plates; the lateral margins reach the katepisterna.

Abdomen: blue or orange and black; terga 1-9 with black, dorsal, longitudinal stripes from bases to the apices, stripes widened near the apex on 2-7 and narrowed on 9, lateral surfaces of all terga, basal rings on 3-7, and apical ring on 1 yellow or bluish; all of segment 10 yellow or blue.

Measurements: total length, male 32-35, female 34-35 mm.; length of abdomen, male 26-28, female 26-28 mm.; length of hind wings, male 17, female 18-20 mm.; width of hind wings, male 3.5, female 3.5-4.

Connecticut.—West Thompson, 12 July, 1905 (H. L. V.); Hamden, 18 July, 3 August, 1920; Guilford, 27 July, 1920 (P. G.).
New England.—June 17-September 2.

Enallagma vesperum Calvert ⁸

Transactions of the American Entomological Society, 45: 380: 1919.

Nymph.—Color green or buff.

Head: about twice as broad as long, the caudo-lateral angles projecting slightly and with but few spines; first antennal segment dark, remaining ones paler; three mental setae, and five laterals.

Thorax: femora with preapical brown rings; metathoracic wing-cases reaching the middle of the third abdominal segment or beyond.

Abdomen: with strongly developed lateral keels, the spines grouped conspicuously at the apices of the keels, especially on segments 2-6; gills (Pl. II, Fig. 10) lanceolate, frequently greatly widened beyond the middle, usually with two more or less fused cross-bands near the proximal third, and three lighter crescentic ones beyond, which are sometimes wanting; axis dark; median gill without heavy dorsal spines as in *signatum*, the ventral margin of the lateral gills with a thick row from base to the first cross-band.

Measurements: length, 5.5 mm.; length of abdomen, 9 mm.; length of gills, 5.5 mm.; length of metathoracic wing-cases, 4.1 mm.; length of median lobe, 1.8 mm.; width of median lobe, .5-1.5 mm.

Adult, male.—Color lemon-yellow, or very pale blue and black (the majority of the specimens are yellow and the blue tenerals are infrequent).

Head: yellow and black; labium yellow; antennae brown and pale, the first and basal two-thirds of the second pale, remainder dark brown; postclypeus almost entirely black or dark, the black usually enclosing two small yellow spots; anteclypeus and labrum yellow, the latter with a small dorso-mesal black spot and a lateral one on each side; front above the clypeus nearly to the median ocellus, yellow; remainder of the front black except a small spot cephalo-ventrad of each lateral ocellus. Postocular spots large, cuneiform, connected with the narrow stripe behind the ocellar area; occiput and postgenae largely yellow.

Thorax: yellow and black; pronotum, with yellow cephalic lobe, a large spot on each median lobe and smaller near the mesal line (four in all); caudal lobe with pale margin; proepimera mostly yellow; mesothorax with black mid-dorsal stripe, the margins of which often fade into brown; dark stripe of the meso-

⁸ *pollutum* Hagen.

pleural suture often reduced to an indefinite brown area near the middle of the horizontal portion of the suture, black spots adjacent to the dorsal margin of the katepisterna and cephalad of the wing bases; dorsal third of the mesokatepisterna with crescentic dark marks; metapleural suture with black spot cephalad of the wing bases; remainder of the mesopleura and metapleura yellow; legs mostly yellow, the coxae and trochanters pale, femora with a faint dorsal line, the tibiae also with a faint dorsal line or row of dashes; tarsi and claws tipped with brown, wings with 9-11 postnodal cross-veins in the front wing, and M_2 arising between the fourth and fifth of these.

Abdomen: yellow and black, the dorsum of terga 1-8 inclusive with black longitudinal stripes from near their bases to apices; lateral margins of 1-8, basal rings on 3-7, and a narrow apical ring on 1, yellow; all of the ninth and tenth terga blue, except a narrow mesal stripe on the tenth; anal appendages (Fig. 10, No. 14) brown, the superiors longer than the inferiors, broad at their apices; inferiors yellow, their black apices directed mesad.

Female.—Color lemon-yellow or pale blue, and black.

Head: as in the male.

Thorax: mesostigmal plates (Fig. 11, No. 4) with rounded lateral margins which are contiguous with the katepisterna. Mesopleural stripes of the suture less distinct than in the male.

Abdomen: similar to the male except that terga 9 and 10 are usually yellow, the ninth having a triangular black dorsal spot.

Measurements: total length, male 32-34, female 32-34 mm.; length of abdomen, male 26-28, female 26-28 mm.; length of hind wings, male 17-19, female 18-21 mm.; width of hind wings, male 3.5-4, female 3-3.5 mm.

Connecticut.—Hamden, 18 July, 1920; Litchfield, 22 July, 1920; Guilford, 13, 27 July, 1920; North Branford, 22 June, 1922 (P. G.).

New England.—June 8-September 6.

Group 2 CIVILE-CARUNCULATUM Group.

Enallagma calverti Morse

Psyche, 7: 208: 1895.

Nymph.—Color buff.

Head: labium extending to the second pair of coxae; mental setae 4; lateral setae 6; marginal setae of the mentum 4 or 5.

Thorax: metathoracic wing-cases extending to the middle of abdominal segment 4 in some nymphs.

Abdomen: segments 3-10 with dorsal transverse rows of setae at the caudal margin, lateral keels strongly developed, setose, the keel of the first segment with a number of spinules (3), the second keel with 8 or 9, 3-8 with 10-12 spinules, and 9 with a row in line with the preceding lateral keels; gills very long, somewhat spatu-

late, the points mostly blunt, and the dorsal marginal row of setae of the median gill extending much beyond the middle; three narrow transverse bands sometimes occur just beyond the middle; they are usually placed close together, but the bands may be reduced in number or wanting.

Measurements: length, 15 mm.; length of abdomen, 9 mm.; length of gills, 1.8 mm.; width of gills, 1.8 mm.; length of median lobe, 2.3, width, .8-1.6 mm.

Adult, male.—Color blue and black.

Head: face below the antennae pale except the postclypeus, which is mostly black; dorsum of head dark, the lateral ocelli with a blue spot in front of each, the postocular spots large, cuneiform, sometimes connected with the narrow blue postocellar stripe; rear of head pale.

Thorax: blue and black; pronotum mostly black with a large blue spot on each median lobe, the caudal margin and the cephalic also blue; proepimera blue or pale below, black above. Mesothorax sometimes with a blue dorsal carina, the black on each side about half the width of the anepisternum; black stripe of the mesopleural suture considerably narrowed caudad; remainder of the pleura except small spots near the wing-bases on the sutures, blue; femora dark above; tibiae with a dorsal line including the cephalic row of setae; tarsi brown, darker at tips; wings clear, M_2 usually arising between postnodal cross-veins 4 and 5 in the hind wings.

Abdomen: blue and black; terga 1-5 inclusive with a black spot at base of 1, subapical spot and apical ring on 2 and apical spots and rings on 3-5; caudal half of 6 and three-fourths of 7 black; 8 and 9 blue; segment 10 black above, pale below. Anal appendages (Fig. 10, No. 23) short, the superiors rounded when viewed in profile, inferiors much longer, slender, acute and black at their tips.

Female.—Color blue and black, the blue, however, frequently replaced with buff. Mesostigmal lamina black, with a pale spot on the lateral angles, the cephalo-mesal angle of each not rounded and hollowed out, as in *cyathigerum*.

Abdomen: as in *cyathigerum* (Fig. 11, No. 25). First tergum as in male, second segment with an apical spot and dorso-mesal line; 3-6 with dorsal stripes widened subapically; caudal half of 8 and all of the dorsum of 9 and 10 black; 8 variable in amount of black.

Measurements: total length, male 33-35, female 34 mm.; length of abdomen, male 26, female 26 mm.; length of hind wings, male 19, female 21 mm.; width of hind wings, male 4, female 4-4.5 mm.

Though we have no very definite record of this species from Connecticut, I have seen several specimens collected in the vicinity of Storrs which are undoubtedly *calverti*.

New England.—May 12-August 12.

Enallagma carunculatum Morse

Psyche, 7: 208: 1895.

Nymph.—Color green or buff.

Head: about twice as broad as long, the caudo-lateral margins with a few spinules. Mental setae three, sometimes a small fourth on each side; labium extending between the first and second pair of coxae; first two antennal segments and proximal third of number 3 dark brown.

Thorax: legs pale, the apical ring of the femora faint or absent; metathoracic wing-cases extending about to the middle of the fourth abdominal segment.

Abdomen: with well-developed lateral keels, those of the first segment with 4 or 5 spines each, the second with 8 to 12 each, five and six with 18-20, and the seventh and eighth with about 14 each; spines of the fifth and sixth keel bunched at the apex; sometimes as many as three together; usually without small setae on the venter of cephalic segments, but usually with long hairs on dorsum of 2, 3 and 4. In mature nymphs there is an indefinite dark dorsal stripe extending from near the apex of the third segment to the seventh or eighth; gills (Pl. II, Fig. 3) transparent, lanceolate with a broad opaque area along the axis from base to near the tip; dorsal marginal spines of the median gill more than 20 in number, and extending one-third to one-half the length of the gill from the base; the ventral spines of the same gill consisting of only a few; ventral spines of lateral gills similar to the dorsal spines of the median; ovipositor of the female extending to the middle of the tenth segment.

Measurements: total length, 13.5-14 mm.; length of abdomen, 8-9 mm.; length of gills, 5.5-6 mm.; width of gills, 1.2 mm.; length of metathoracic wing-cases, 3.6 mm.; length of median lobe, 2.5, width .5-2 mm.

Adult, male.—Color dark blue or buff, and black.

Head: blue or buff and black, the labium buff, antennae black, the first segment sometimes paler at apex; postclypeus with a large, shining black spot, the ventro-lateral margins pale; anteclypeus and labrum except a dorso-mesal black spot and a lateral spot on each side, pale; front above the clypeus to the bases of the antennae pale, remainder black; postocular spots oval, buff or blue, and not usually connected with transverse line caudad of the ocelli; occiput and postgenae mostly pale.

Thorax: blue or buff, and black, the pronotum black with cephalic lobe, caudal margin of the caudal lobe, and small spots on the lateral margins of the median lobes blue or buff; pale stripe of the anepisterna of mesothorax regular, the margins nearly parallel and straight, the stripe extending from the cephalic margin nearly to the wing-bases; black stripe of the mesopleural suture widest caudad of the katepisterna, extending onto

and covering about the dorsal third of that sclerite; metapleural suture with a black spot adjacent to the wing bases; remainder of the pleura and the venter, blue or buff; legs striped, the coxae and trochanters usually pale, the femora with broad dark dorsal stripes; tibiae with dorsal stripes covering about half the dorsal surface of each, and including the cephalo-ventral row of spines; tarsi and claws pale, usually black at tips; front wings with 9-13 postnodal cross-veins and M_2 arising between the fifth and sixth of these.

Abdomen: black and blue or buff; terga 1-6 inclusive blue or buff and black; a small black spot on 1, apical ring and dorsal spot occupying half the second and third, more than half the fourth, and two-thirds of the fifth and sixth; seventh tergum black except narrow lateral margins and a basal ring; terga 8 and 9 blue, dorsum of 10 black; anal appendages (Fig. 10, No. 9) short, the superiors usually black, blunt and with a narrow notch on the dorsum cephalad of, but near the caudo-dorsal angle; inferiors pale, the black apices directed dorsad and frequently in contact with the superiors.

Female.—Color similar to the male. Mesostigmal plates as in Fig. 11, No. 1.

Abdomen: as in Fig. 11, No. 23, the black of the dorsum frequently not reaching the cephalic margins of the terga.

Measurements: total length, male 31-33, female 29-32 mm.; length of abdomen, male 26, female 25 mm.; length of hind wings, male 19, female 19 mm.; width of hind wings, male 4, female 4 mm.

Connecticut.—North Colebrook, 19 June, 1920; Salisbury, 20 August, 1921 (P. G.).

New England.—June 19-August 20.

***Enallagma civile* (Hagen)**

Synopsis of the Neuroptera of North America, 88: 1861.

Nymph.—Color green or buff.

Head: about twice as broad as long, the caudo-lateral angles not projecting caudad or laterad, conspicuously; antennae with third segment longest, the first two segments and proximal portion of 3 dark brown, the remainder of 3 and segments beyond pale; median lobe of labium with four mental setae, labial palpi with five or six.

Thorax: buff or green; legs pale, the preapical femoral rings indistinct; metathoracic wing-cases extending about to the middle of abdominal segment 4.

Abdomen: pale buff or green, frequently with an indefinite darker stripe on segments 3-7; dorsum of terga 2, 3 and 4 with long hairs; lateral keels setose, the first, however, without setae;

segments 2-9 with from 9-20 on each. Gills (Pl. II, Fig. 8) lanceolate, colorless and usually without pigment except in the smaller tracheae, the margins very transparent; dorsal marginal spines of the median gill extending less than half the length of the gill from its base; ventral row of lateral gills slightly longer. Female ovipositor extending to the middle of the tenth abdominal segment.

Measurements: length 15 mm.; length of abdomen 10 mm.; length of gills 6 mm.; width of gills 1.8-2.1 mm.; length of meta-thoracic wing-cases 4.5 mm.; length of median lobe 3.1 mm.; width of median lobe .8-2.3 mm.

Adult, male (Pl. XVII, c).—Color blue and black.

Head: blue and black; mouth-parts buff; antennae dark brown or black; postclypeus with a shining black spot, margins pale; anteclypeus shining yellow or blue; labrum shining yellow or blue, with a small, black dorso-mesal spot; area above the clypeus to the antennae pale; remainder of front and the vertex dull black; postocular spots oval or subcuneiform, the pale line behind the ocelli indistinct; occiput and postgenae yellow, except the area caudoventrad of the postocular spots.

Thorax: blue and black; pronotum black, except the pale cephalic and caudal margins and a spot on each median lobe on the lateral margins; proepimera black above, pale below; mesothorax, lateral half or third of the mesostigmal plates usually yellow; dorsal black stripe covering nearly half of each anepisterna; pale stripe of anepisterna broadest dorsad of the katepisterna and extending nearly to the wing bases. Mesopleural black stripe of the suture narrowed cephalad of the wing-bases, and broadest caudad of the katepisterna, the dorsal third of which is covered by the stripe. Metapleural suture with a black spot cephalad of the wing bases, remainder of the pleura blue and buff; postcoxal areas buff, becoming pollinose; legs striped, the coxae and trochanters pale, the femora with black on the dorsum, the tibia with about half the dorsa black; tarsi and claws pale, darker at tips; front wings with 9-13 postnodal cross-veins, the vein M_2 arising between the fourth and sixth of these.

Abdomen: blue and black, the cephalic terga largely blue, the caudal ones darker and frequently pollinose with age; terga 1-6 inclusive blue except a basal spot on the dorsum of 1, and shield-shaped apical spots on 2-6; black of 6 occupying half the dorsum or more; that of 2 to 5 about one-fourth; terga 7 and 10 black, except the lateral margins, 8 and 9 blue; anal appendages (Fig. 10, Nos. 1, 5, 29) short, the superiors blunt and with a narrow cleft or notch ventrad of the dorso-apical angle; inferiors usually black and shorter, the black tips directed caudo-dorsad and frequently in contact with the superiors.

Female.—Color similar to the male though usually darker in general appearance.

Thorax: legs usually lighter than those of the male. Mesostigmal plates as in Fig. 11, No. 3.

Abdomen: lateral margins of the terga yellowish, the basal rings on 2-6 (Fig. 11, No. 24) usually not connected across the dorsum as in *carunculatum*.

Measurements: total length, male 29-33, female 30-32 mm.; length of abdomen, male 23-27, female 23-27 mm.; length of hind wings, male 17-20, female 19-20 mm.; width of hind wings, male and female 3.5-4 mm.

Connecticut.—New Haven, 23 June, 1904 (H. L. V.), 3, 20 July, 1904 (W. E. B.); Whitneyville, 11 August, 1904 (P. L. B.); Hamden, 18 July, 1920; Branford, 21 July, 11 August, 1921; Guilford, 13, 27 July, 1920 (P. G.); New London, 7-22 June, 1921 (R. H. H.).

New England.—May-September 22.

Enallagma cyathigerum (Charpentier)

Libellulas Europas, 163: 1840.

Nymph.—This species has not been reared in America and it may be found to differ from that obtained from Europe and described in the Zygoptera of Illinois, pp. 534-535. It will undoubtedly be found to be closely related to the nymph of *calverti* and has been placed at the same point in the specific key.

Adult, male.—Color blue and black.

Head: blue and black; postclypeus black; antennae black; postocular spots large, rounded, and sometimes connected with the pale color of the occiput.

Thorax: blue and black; legs black above, pale beneath; black stripe of the mesopleural suture narrowed caudad; wings with 10 to 11 postnodal cross-veins in the front wing and 10 in the hind; postnodal cross-veins arising near the fifth postnodal vein or beyond in the front and between 4 and 5 in the hind.

Abdomen: blue with black as follows: spot at base of 1; spots at apices of terga 2 to 5 inclusive; caudal half or three-fourths of dorsum of 6; nearly all of seventh dorsum and all of the tenth; segments 8 and 9 blue; anal appendages as in Fig. 10, No. 15, the superiors black or quite dark, inferiors pale.

Female.—Similar to the male in color; pronotum without conspicuous pits; mesostigmal plates (Fig. 11, No. 11) hollowed at the cephalo-mesal angles. Color pattern as in Fig. 12, No. 25.

Measurements: total length, male 30-32, female 31-32 mm.; length of abdomen, male 24-26, female 25-26 mm.; length of hind wings, male 16-21, female 19-20 mm.

Connecticut.—Orange, 2 June, 1920; Stratford, 9 July, 1920; Hamden, 18 July, 1920; Twin Lakes, 13 June, 1926 (P. G.).

Enallagma doubledayi Selys

Revue des Odonates ou Libellules d'Europe, 209: 1850.

Nymph.—Gills (Pl. I, Fig. 12) transparent, the tracheae almost entirely without small branches, and the marginal spines extending well beyond the middle of the gills; dorsum of abdominal segments 2, 3, and the base of 4 hairy; mental setae 3, and a small fourth, laterals 5; lateral keels with a single row of spines increased to two at the apices; caudo-lateral margins of the head rounded and with a few spines.

Measurements: length of gills, 5.5-6 mm.; width, 1.25-1.5 mm.

Notes made from a nymph reared by Dr. R. H. Howe, Jr.

Adult, male.—Color blue and black.

Head: blue and yellowish and black; antennae brown; anteclypeus and labrum yellow; postocular spots small and a narrow stripe caudad of the ocelli distinct.

Thorax: black, blue and yellowish green; mesothorax with a broad black dorsal stripe, the stripe covering about one-third of the katapisterna on each side; legs black and yellow, the femora and tibiae each with a black stripe on dorsum or cephalic surface, wings with about 10 postnodal cross-veins in the front wing and 8 in the hind; M_2 arising between the fifth and sixth postnodal cross-veins in the front wing and between the fourth and fifth in the hind wing.

Abdomen: blue and black; terga 1-10 blue except a small basal spot on the first, and apical spot and marginal ring on the second to the fifth, apical half or two-fifths of the dorsum of the sixth; dorsum of the seventh except a narrow interrupted basal ring, and the tenth, which are black; dorsum of segments 8 and 9 blue; anal appendages similar to *carunculatum* and *civile* but the superiors differ especially in dorsal view (Fig. 10, Nos. 25, 28).

Female.—Abdomen with terga 1 to 10 with broad dorsal dark stripes and basal interrupted rings, the lateral margins pale.

Measurements: total length, male 28-31, female 30-31 mm.; length of abdomen, male 22-25, female 24 mm.; length of hind wings, male 17; female 18 mm.

New England.—June 28-September 13.

Group 3 HAGENI-EBRIUM Group

Enallagma ebrium (Hagen)

Synopsis of the Neuroptera of North America, 89: 1861.

Nymph.—Color usually green.

Head: elliptical in outline, with a few spines on the caudo-lateral surfaces; antennae with the first segment brown, also half the second and one-third the third; third segment longest, number 2 longer than 1; labium extending between pro- and mesocoxae

when folded; mental setae three and a small fourth; lateral setae five.

Thorax: femora with dark subapical rings, sometimes the tips of the tibiae and tarsi faintly darker; metathoracic wing-cases extending to the middle of abdominal segment 4, sometimes to 5.

Abdomen: with conspicuous spots on segments 1-7, two on each segment, one above and one below the lateral keel; there is also a similar spot on each side of segment 8 above the lateral keels; dorsum of terga 2, 3 and 4 densely hairy, lateral keels 2-8 with spinules and minute setae, the spines grouped at apices of 2-5 and not usually more than 7 or 8 on these segments; keel of segment 1 without spinules or setae.

Gills (Pl. 1, Fig. 8): clear, with some transparent and some black tracheae, the black tracheae frequently separated from the main axis by clear stretches; in others forming alga-like patches as in *exulans*; tips of gills comparatively blunt, the dorsal and ventral marginal spines not usually reaching beyond the middle of the gills, although in one reared specimen the spines extend well beyond the middle.

Measurements: length, 12-13 mm.; length of abdomen, 8 mm.; length of gills, 4-5 mm.; length of metathoracic wing-cases, 3.7 mm.; length of median lobe, 2 mm.; width of median lobe, .5-1.5 mm.

Adult, male.—Color blue and black.

Head: black and blue; antennae black except the tip of the first and second segments; postclypeus black except sometimes the front margin; front above clypeus to bases of the antennae pale; remainder of the front and vertex black; postocular spots large, subcuneiform, the margins irregular; occiput and post-genae pale except a transverse black area behind the postocular spots.

Thorax: blue and black; pronotum black, cephalic lobe pale, median lobes with a pale spot on each lateral margin, and caudal lamina also pale; propleura black above, pale below; dorsal mesothoracic black stripe occupying one-third to one-half of each anepisternum, the lateral margins parallel; pale stripe of the anepisterna extending from cephalic margin to near the wing bases, widest above the katepisterna; black stripe of the mesopleural suture widest caudad of katepisterna; a black spot on the metapleural suture cephalad of the wing bases; remainder of the pleura blue, the postcoxal areas blue or buff; legs striped black and blue or buff, femora black above with a pale spot at base, appearing as an emargination of the black band but obscured in older specimens; cephalic half of the dorsum of the tibiae black; tarsi and claws brown, darker at the tips of the segments; wings with 9-11 postnodal cross-veins in the front wing, and M_2 arising between the fourth and fifth of these.

Abdomen: blue and black; terga largely blue, with black spot on base of 1, and apices of 2-6 inclusive, all of the dorsum of 7 black except a basal interrupted ring; dorsum of 10 black; terga 8 and 9 blue; anal appendages (Fig. 10, No. 17) short, black, the superiors bifid, the two arms equal in length; dorsal arm of superior appendages black at tip and forming a blunt hook when viewed from above; inferior appendages pale, dark at tips and about as long as the superiors.

Female.—Color black and yellow or blue.

Head: with the blue of the male sometimes replaced with yellow.

Thorax: similar to the male; mesostigmal plates as in Fig. 11, No. 5.

Abdomen: broad dorsal black stripes on segments 2-10, the stripes contracted at the meson on the bases of terga 3-7 inclusive, widened subapically on terga 2-7; first tergum with black basal spot.

Measurements: total length, male 27-31, female 27-31 mm.; length of abdomen, male 21-25, female 22-24 mm.; length of hind wings, male 15-17, female 16-18 mm.; width of hind wings, male and female 3-4 mm.

Connecticut.—West Thompson, 12 July, 1905 (H. L. V.); New Haven, 11 June, 1914 (B. H. W.); Guilford, 13, 27 July, 1920; Hamden, 4 July, 3 August, 1920, 30 May, 1922; Litchfield, 22 July, 1920; Branford, 21 July, 1920 (P. G.); New London, 8-22 June, 1921 (R. H. H.).

New England.—May 26-August 30.

Enallagma geminatum Kellicott

Entomological News, 6: 239: 1895.

Nymph.—Color usually green.

Head: about three times as broad as long, elliptical; the caudo-lateral angles not projecting, and possessing few spines; third antennal segment longest, the second longer than the first, segments 1-3 or 1-4 dark in color; median lobe of the labium with 3 mental setae and sometimes a small fourth; 5 lateral setae.

Thorax: femora without dark rings near the apex, or with very faint ones; tarsal claws dark at the tips.

Abdomen: with lateral keels on segments 1-8, the first without spines or with 2; second with 3-5, third with an irregular single row, 4-8 with irregular single rows with sometimes 2 spines at their apices; segment 9 has an irregular row of setae in line with the keels of the preceding segments; dorsum of segments 2, 3 and 4 hairy; a darker line present just below the lateral keels on segments 1-8; few or no spines on venter of 1-4.

Gills: spatulate to lanceolate (Pl. 1, Fig. 7) without pigment except in the smaller tracheae, and sometimes a trace along the axes; dorsal marginal spines of the median gill and ventral spines of the lateral gills extending much less than half the length of the

gills from their bases, and usually less than 20 spines on dorsal margin of the median gill.

Measurements: length, 11-12 mm.; length of abdomen, 9 mm.; length of gills, 4.7 mm.; width of gills, 1.3 mm.; length of meta-thoracic wing-cases, 2 mm.; length of median lobe of labium, 2; width, .6-1.5 mm.

Adult, male.—Color pale blue, black and buff.

Head: blue and black, mouth-parts buff, with a tinge of blue in fresh specimens; antennae dark brown or black, the tips of the first and second segments sometimes pale; postclypeus shining black, except the lateral angles which are blue; anteclypeus and labrum blue, the labrum with a dorso-mesal black spot; frontal area above the clypeus to the level of the antennae blue, remainder of the front black; postocular spots large, blue, rather irregular, and frequently with serrated margins; pale stripe caudad of ocelli wanting; occiput and postgenae mostly buff, compound eyes brown above, pale below.

Thorax: blue and black, buff below; pronotum black, the cephalic and caudal lobes mostly blue, median lobes black; propimera largely blue, mesostigmal plates, with blue lateral angles and caudal margins; mesothorax with the dorsal black stripe covering half or one-third of each anepisternum, the blue stripe of that sclerite contracted at the caudal third or fourth, and occasionally interrupted, forming an exclamation point; black stripe of the mesopleural suture widest adjacent to the katapisternum, and covering the dorsal half of that sclerite; metapleural suture black; ventral half of the mesepimera, and the metapleura blue; postcoxal areas pale or buff; legs striped, black and blue or buff; tarsi and claws black, pale in tenerals; wings with 7-10 postnodal cross-veins in the front wing, and M_2 arising between the fourth and fifth of these.

Abdomen: blue, buff, and black; tergum 1, blue with a black basal spot; second tergum blue with black dorsal spot, apical ring and lateral stripe on each side near the margin; terga 3-7 with longitudinal black stripes on the dorsum from the bases to the apices, the stripes widened subapically, connected with the apical rings which reach the lateral margins of the sclerites; dorsum of 10, narrowed lateral margins of 8 and 9, black or dark brown; dorsum of 8 and 9 blue; basal rings, usually interrupted on the meson in 5-7, pale yellow or blue. Anal appendages (Fig. 10, Nos. 3, 7) black and buff, the superiors black with paler tips, inferiors slightly longer than the superiors, yellowish, with the black tips directed mesad.

Female.—Color similar to the male.

Head: dorsal half of labrum usually brown.

Thorax: mesostigmal plates as in Fig. 11, No. 13.

Abdomen: with broader black stripes on 2-7; terga 9 and 10

brown or black, lateral margins pale; 8, brown or black with large blue spots occupying the larger portion of the sclerite and separated from one another by a mesal line of black (Fig. 11, No. 22); dorso-apical margin of 7 and 8 blue.

Measurements: total length, male 26-27, female 26-27 mm.; length of abdomen, male 20-21, female 21 mm.; length of hind wings, male 15, female 16 mm.; width of hind wings, male 3.5, female 3-4 mm.

Connecticut.—Mount Carmel, 23 June, 1902 (E. J. S. M.); New Haven, 26 June, 1902 (E. J. S. M.), 23 June, 1904 (H. L. V.), 11 June, 1914 (B. H. W.); 1 June, 1921 (M. P. Z.); Guilford, 30 July, 1920; Hamden, 30 May, 1922 (P. G.), 6 July, 1922 (J. L. R.); New London, 22 June, 1921 (R. H. H.).

New England.—June 15-October 2.

Enallagma hageni Walsh

Proceedings of the Entomological Society of Philadelphia, 2: 234: 1863.

Nymph.—Color buff or greenish.

Head: subelliptical, the caudo-lateral angles projecting slightly caudad and armed with a few heavy setae; antennae with the third segment longest, the second longer than the first; labium extending to the second pair of coxae, the mental setae of the median lobe three, the lateral setae usually five, and the marginal setae usually three or four.

Thorax: legs with faint preapical femoral rings of brown; tarsi and claws pale; metathoracic wing-cases extending to the middle of the fourth abdominal segment.

Abdomen: a row of spots on the cephalo-lateral angles of the terga and sterna of segments 2-9; lateral keels strongly developed, setose, the first keel usually without setae, the second, third and fourth with a bunch of four or five at the apices, the fifth with about five apical setae and a weaker row extending to the base of the segment; sixth, seventh and eighth keels with six setae at the apices and a proximal row of about nine setae on each; segment 9 without lateral keel, but with a row of setae along the line of the lateral keels, composed of two heavy setae near the caudal margin and a straight row of six smaller setae extending cephalad to the margin of the segment; cuticle of the abdomen without dark spots at the bases of the minute setae which cover the surface; dorsum of segments 2, 3, and base of 4 with long hairs; gills (Pl. 1, Fig. 9) lanceolate, almost colorless, widest beyond the middle and rather obtusely pointed; tracheae pigmented in certain areas which form about twelve alga-like patches around the margins of the gills; dorsal marginal setae of the median gill extending half way from the base to the tip and composed of more than twenty setae; ventral setae of the lateral gills extending more than half-way from the base to the tips of the gills; apical margins with a few scattered hairs.

Measurements: length, 14-15 mm.; length of abdomen, 9 mm.; length of gills, 5 mm.; width of gills, 1.8 mm.; dimensions of median lobe, 2 mm. by .7-1 mm.

Adult, male.—Color blue and black.

Head: face below antennae pale except a black spot on postclypeus; dorsum of head black; postocular spots large, subcuneiform, and not connected with the postocellar stripe.

Thorax: black and blue or buff; pronotum dark with pale cephalic and caudal margins and a semicircular spot on each side near lateral margins. Coxae and trochanters pale; femora brown above with a pale spot on one side at base; tibia with cephalic half of dorsum black; tarsi and claws brown, sometimes pale above. Mesothorax with a heavy black stripe on the suture, widened at the hind margin of anepisternum; remainder of meso- and metapleura pale except a small black spot on metapleural suture near wing bases; venter pale. Wings clear, M_2 arising between postnodal cross-veins 3 to 5 in the front, and 3 to 4 in the hind wings.

Abdomen: blue and black, the terga with black as follows: basal spot on 1, apical spots and rings on terga 2-6 inclusive, the spots not over one-fourth or one-fifth⁹ as long as the segments (on 3-6), all of 7, and dorsum of 10 also black; terga 8 and 9 blue. Anal appendages (Fig. 10, No. 11) consisting of flattened superiors and longer inferiors.

Female.—Color similar to the male; mesostigmal plates broad (Fig. 11, No. 6), the caudal margin rounded and elevated; pronotum with two conspicuous pits, caudad of the middle one on each side and usually just behind the pale lateral spots.

Measurements: total length, male 30, female 28 mm.; length of abdomen, male 22, female 22 mm.; length of hind wings, male 17, female 18 mm.; width of hind wings, male 3.5, female 3.5 mm.

Connecticut.—Salisbury, 13 June, 1926 (P. G.); 14 July, 1926 (W. E. B.).

New England.—May 30-August 10.

***Enallagma laterale* Morse**

Psyche, 7: 274: 1895.

Nymph.—Not available for study.

Adult, male.—Color blue and black.

Head: pale below the antennae except a transverse black stripe on the postclypeus; dorsum of head black, pale postocular spots comma-like; rear of head mostly pale.

Thorax: pronotum black, the cephalic margin pale; propleura pale below; femora dark above, pale below, tibiae with dark line covering the cephalic setae. Tarsi and claws brown, darker at

⁹ Walker (Can. Ent. 56, 173: 1924) describes a specimen with dark abdomen, but this seems to be unusual.

tips; meso- and metathorax with usual mesepisternal pale stripe, and black stripe on the suture, metapleura and venter of thorax mostly pale; M_2 of the hind wing arising between post-nodal cross-veins 3 and 4.

Abdomen: mostly pale (blue?), black as follows: basal spot on 1; apical spot and ring on 2-5 inclusive; about two-thirds of terga 6, and all of dorsum of 7 except an interrupted basal ring, black; terga 8, blue with black lateral dashes, 9 entirely blue; segment 10 black on dorsum, yellow below; anal appendages short, the superiors blunt and feebly emarginate in lateral profile (Fig. 10, No. 21), the inferiors pale, darker at tips, and a little longer than the superiors.

Measurements: total length, male 25 mm.; length of abdomen, male 19 mm.; length of hind wing, male 16 mm.; width of hind wing, male 3 mm.

Connecticut.—A single male collected by Dr. R. H. Howe at New London, June 6, 1921, belongs here.

Enallagma minusculum Morse

Psyche, 7: 207: 1895.

Nymph.—Unknown.

Adult, male.—Color blue or buff and black.

Head: face pale below the antennae except for a transverse black spot on the postclypeus; dorsum of head black; postocular spots subcuneiform (comma-shaped), postocellar stripe wanting or very narrow.

Thorax: pronotum black, except the cephalic margin, the propleura pale below; dorsum of femora and cephalic stripe on the tibiae black; tarsi pale, darker at tips; pale stripe of the mesothorax a trifle narrowed caudad, the black stripe of the mesopleural suture a little wider than the pale stripe, and widest just behind the katapisterna; remainder of the pleura, except small spots near wing-bases on the sutures, blue or pale brown; venter of thorax pale; M_2 arising between postnodal veins 3 and 4 in the hind wing.

Abdomen: mostly black, the first segment with large lateral blue spot and a smaller blue spot on the dorsum at apex; 2 with cephalic half and lateral margins blue; 3-7 with blue cephalic portions, the blue decreasing successively caudad, occupying a little less than one-half of 3, and reduced to a small spot on 7; 8 and 9 entirely blue; 10 black above, pale below; anal appendages black (Fig. 10, No. 10), the superiors with a large ventral lobe when viewed in lateral profile, the inferiors slender and but little longer than the superiors.

Female.—Color similar to the male.

Head: similar to male.

Thorax: pronotum without pits or yellow spots on the entirely black median lobe. The mesostigmal plates are narrow, the caudal margins almost straight, and have a pale spot on the lateral angle sometimes occupying more than half the plate. The mesopleural pale stripe is much contracted at the mesostigmal plates and is in contact with them only at the lateral angles.

Abdomen: terga with dorsa of 1-10 black or dark from base to apex.

Measurements: total length, male 25-26, female 25 mm.; length of abdomen, male 20, female 19 mm.; length of hind wings, male 14-15, female 15 mm.; width of hind wings, male 3.5, female 4 mm.

Described from three males obtained through the kindness of Dr. R. H. Howe, and a female from Dr. P. P. Calvert.

***Enallagma recurvatum* Davis**

Journal New York Entomological Society, 21: 15-16: 1913.

Nymph.—Unknown.

Adult, male.—Color blue and black.

Head: labrum blue; anteclypeus blue, postclypeus mostly black; face blue to the level of the antennae; postocular spots oval or comma-shaped; postocellar stripe wanting; rear of head mostly pale.

Thorax: pronotum entirely black except small spots on the lateral angles of the caudal lobe; propleura largely pale; meso- and metathorax with narrow blue stripe on each mesepisterna, the stripe contracted and sometimes interrupted, forming an exclamation point; ventral half of the mesepimera and all of the metapleura blue, except a small black spot on the metapleural suture at the wing bases; legs with femora dark above, the tibiae with black stripe, tarsi dark brown or black, the claws with ventral tooth well beyond the mid point, near the distal fourth; wings with M_2 arising near the fourth postnodal cross-vein in the front wing but usually well proximad of this point in the hind wing.

Abdomen: tergum 1 with basal half of dorsum black, remainder blue; 2 blue except a black spot covering the caudal half of the dorsum; 3 blue with dorsal spot occupying caudal third or a little more; 4 with dorsal spot covering about half the dorsum; 5 and 6 with similar spots covering nearly four-fifths of each; 7 black except basal rings and lateral margins; 8 and 9 blue, 8 sometimes with a narrow black line on the sides; 10 black above, pale on sides; anal appendages with the superiors strongly upturned at tip in lateral profile, the inferiors considerably longer.

Measurements: total length, 26-27 mm.; length of abdomen, 20-22 mm.; length of the hind wings, 14-15 mm.

Three male specimens received from Mr. Wm. T. Davis, and collected at Wyandanch, Long Island, New York. No females of this species have been seen; all supposed females thus far examined have proved to belong to other species.

Group 4 EXSULANS-TRAVIATUM Group

Enallagma divagans Selys

Bulletin de l'Academie royale . . . de Belgique, 41: 521: 1876.

Nymph.—Unknown.

Adult, male.—Color blue and black.

Head: face blue to the level of the antennae, except the postclypeus and spot on labrum, which are black; postocular spots large, blue, very narrowly separated from the postocellar stripe; rear of head mostly pale, black on each side of the occipital foramen.

Thorax: pronotum mostly black, the cephalic lobe, a spot on each side of the median lobes, and a spot on middle and one on each side of the caudal lobe, blue; meso- and metathorax blue, the black stripe of the mesopleural suture a trifle wider than the pale stripe of the episternum, the pale stripe widened a little at both ends, narrowed at middle; legs pale, the femora each with a black dorsal stripe, the tibiae pale with a faint streak on the front and middle tibiae, the hind tibiae with only a faint row of dashes; tarsal segments and claws pale, darker at tips; wings with M_2 usually arising between the third and fourth postnodal cross-vein in the hind wings.

Abdomen: mostly black, blue on sides; 1-7 inclusive, black above; dorsal black stripe of 2 widened subapically; terga 8 and 9 entirely blue except sometimes a small spot at base of 8 on the dorso-meson; 10 black above, blue on sides; anal appendages dark brown or black, the superiors in lateral profile not distinctly bifurcate, but with a lobe extending ventrad (Fig. 10, No. 27).

Female.—Color similar to the male.

Thorax: mesostigmal plates similar to those of *exsulans* except that the caudal margins are more nearly at right angles to the meson.

Abdomen: eighth tergum black with two pale blue spots on the caudal margin; sides sometimes pale also; 9 with two short dorso-lateral black stripes or triangular spots which fuse at the base on the meson; 10 blue.

Measurements: total length, male 29-33, female 32 mm.; length of abdomen, male 24-28, female 26 mm.; length of hind wings, male 17-18, female 18 mm.; width of hind wings, male 3-3.5, female 3.5 mm.

Connecticut.—Hamden, 11 June, 1927 (P. G.).

Enallagma exsulans (Hagen)

Synopsis of the Neuroptera of North America, 82: 1861.

Nymph.—Color dark brown or greenish.

Head: slightly broader than long, the caudo-lateral angles projecting strongly caudad; second antennal segment shorter than the first, the first two darker than the remaining ones and pilose; mental setae three, laterals usually four, occasionally five.

Thorax: femora with the usual preapical brown rings; apices of the third tarsal segments and the apices of the claws dark; metathoracic wing-cases extending to the fourth abdominal segment.

Abdomen: cuticle with minute dark spots and setae, the cuticle, however, uniform brown in some; lateral keels on segments 4-8 and lateral apex of segment 9 with groups of 2-6 spines; dorsal surface of keels with minute setae; gills (Pl. II, Fig. 9) lanceolate, broadest beyond middle, usually heavily pigmented on the proximal two-thirds, the infuscation being followed by two large clear spots on each side of the axis; tip of gills dark except the extreme tip; dorsal spines of median gill and ventral marginal spines of the laterals extending nearly two-thirds the length of the gills from their bases. Smaller trachea forming alga-like patches. Pigmentation of the gills of younger nymphs is not distinct except for the alga-like patches.

Measurements: length, 12-13.5 mm.; length of abdomen, 9-10 mm.; length of gills, 5.5-7 mm.; width of gills, 1.3-2; length of median lobe, 2 mm.; width, .6-1.8 mm.

Adult, male.—Color blue, black and brown.

Head: blue and black; antennae black; postclypeus shining black, the anteclypeus pale, and the labrum with a transverse black stripe on the dorsal margin; front above clypeus to the antennae pale, remainder of the front and vertex black; postocular spots and postgenae yellow or blue.

Thorax: blue and black; pronotum black, the cephalic lobe blue; large spots on the mesal lobes and smaller ones on the same near the meson; also a blue mesal spot on the caudal lamina; propleura black along the dorsal border, blue below; mesostigmal plates with the lateral angles blue; black stripe of the dorsum of mesothorax occupying about half of each anepisterna; blue stripe of the anepisterna narrowed at the caudal end widest above the katepisterna; black stripe of the mesopleural suture broad extending onto the katepisterna and in younger specimens divided by a brown line directly over the suture; black spots on the metapleural suture near the wing bases, the remainder of the pleura blue; postcoxal areas buff; legs pale blue or brown and black; femora black above, usually with a pale spot at base; tarsi and claws pale, dark at tips; wings with 10-12 postnodal cross-veins in the front

wings and M_2 usually arising between the fourth and fifth of these.

Abdomen: blue and black, dorsum of terga 1-9 and 10 with longitudinal black stripes from base to apex, widened subapically on 2-7, and narrowed to the meson on 8 at the hind margin; lateral surfaces of terga 1-8, 10, all of 9, narrow apical ring on 1 and broad basal rings on 4, 5 and 6, blue or pale; anal appendages (Fig. 10, No. 13) black, the superiors bifurcate, the dorsal arms shortest; inferiors usually paler and shorter than the superiors.

Female.—Color pale green, black and brown; tip of abdomen blue.

Head: postocular spots usually connected with the narrow stripe behind the ocelli; genae and area above the clypeus more or less orange in color.

Thorax: with the brown of the mesopleural dark stripe more conspicuous and persistent than in the male. Mesostigmal plates as in Fig. 11, No. 9, not reaching the katapisterna on the sides.

Abdomen: with broad dorsal stripes on segments 1-8, the stripe on 9 being reduced to two triangular spots (sometimes united) at the base of the tergum, the remainder blue in color; tergum 10 blue; lateral surfaces of 2-8 and narrow basal rings on 3-8 usually pale green.

Measurements: total length, male 31-35, female 30-32 mm.; length of abdomen, male 26-29, female 24-26 mm.; length of hind wings, male 17-19, female 20-23 mm.; width of hind wings, male 3-4, female 3.5-4 mm.

Connecticut.—Putnam, 12 July, 1905 (H. L. V.); Stratford, 9 July, 1920; Guilford, 27 July, 1920 (P. G.).

New England.—May 28-August 27.

Enallagma traviatum Selys

Bulletin de l'Academie royale . . . de Belgique, 41: 517: 1876.

Nymph.—Color very dark brown.

Head: caudo-lateral margins projecting, antennae slender, the first two segments setose and their diameter much greater than the remaining ones; labium extending behind the first pair of coxae; mental setae two, sometimes a small third; lateral setae four.

Thorax: lateral portion of the prothorax and the metapleura darker than the dorsum of the thorax; femora with distinct pre-apical brown rings, tarsi pale.

Abdomen: brown, darker immediately above and below the lateral keels; cuticle without small black spots at the bases of the setae; keels with a few (usually 1 or 2) spines near the apices; gills (Pl. 11, Fig. 4) rather narrowly lanceolate, the median gill without heavy spines on the dorsal margin; lateral gills with ventral marginal row of spines extending one-half or less of the

length of the gill; basal two-fifths or one-half of the gills uniform dark brown, the pigmented area followed by a broad clear band; beyond the clear portion are frequently one or two brown transverse stripes, the apices of the gills being without pigment.

Measurements: length, 11 mm.; length of abdomen, 8 mm.; length of gills, 6 mm.; width of gills, 1 mm.; length of meta-thoracic wing-cases, 3.5 mm.; length of median lobe, 2 mm., width, .5-1.3 mm.

Adult, male.—Color pale blue and black.

Head: blue and black; antennae brown, the first segment sometimes with the cephalic half blue; postclypeus blue with a black spot on each side; anteclypeus blue; labrum blue, with a black dorso-mesal spot, sometimes a lateral spot on each side, the three sometimes connected; front above the labrum to the median ocellus blue; ocelli with small blue spots ventrad; remainder of the front black; postocular spots very large, forming equilateral triangles, and occupying most of the dorsal portion of the occiput; occiput and postgenae pale blue; eyes blue in life.

Thorax: blue and black; pronotum with elongate blue spots on the median lobe, contiguous on the meson, and somewhat crescentic spots of the same color on the sides; proepimera and propisterna brown or blue; mesothorax with a black stripe covering the dorsal carina frequently divided by a line of brown on the carina; black stripe of the mesopleural suture sometimes reduced to a line; mesokatepisterna with crescentic marks on the dorsal borders; remainder of the mesopleura and metapleura (except small spots on interpleural folds and metapleural sutures) blue; postcoxal areas pale; legs striped pale blue or buff and black, the coxae and trochanters blue, femora blue with broad dorsal black stripes frequently interrupted at the base by a pale spot; tibiae pale blue and buff with a short dorsal black stripe or none, the tarsi pale, black at tips; wings with 10-12 postnodal cross-veins in the front wings and 7-10 in the hind; M_2 arising between the fourth and fifth postnodal cross-veins in the front wing and between 3 and 4 in the hind; pterostigma small, subelliptical, and surmounting less than a single cell.

Abdomen: blue and metallic black, the dorsum of the first tergum with a small black basal spot about half its length; second tergum with a black apical shield-shaped spot, the spot extending to the cephalic margin and narrowed at this point to a line on the meson; terga 3-7 inclusive, with longitudinal black stripes widened subapically and narrowed basally, the lateral margins of the terga pale; terga 8 and 9 usually entirely blue, the eighth sometimes with a dark basal spot on the dorsum; tergum 10 black; anal appendages (Fig. 10, No. 6) short and black, the superiors longer than the inferiors and appearing slightly knobbed at the apices when seen in lateral profile; viewed from above, the superior

appendages are seen to have broad basal lobes, which are often contiguous; inferior appendages short, subconical, and directed obliquely dorsad; tenth sternum pale.

Female.—Color similar to the male.

Head: front with more blue, and the spots ventrad of the ocelli larger than in the male and sometimes connected with the blue area of the front.

Thorax: dorsal black stripe divided by a brown line on the meson; mesostigmal plates (Fig. 11, No. 8) pale blue, the lateral angles elevated and not reaching the katapisterna.

Abdomen: (Fig. 11, No. 21) dorsum of tergum 1 with a black basal spot, 2-7 inclusive with longitudinal dorsal black stripes widened suddenly near the caudal margins, and narrowed to the meson near the cephalic margins; tergum 8 blue with a narrow dorsal stripe extending a little over half the length of the tergum from the base; terga 9 and 10 blue, 9 sometimes with two black basal triangles.

Measurements: total length, male 27-31, female 29-31 mm.; length of abdomen, male 22-25, female 23-25 mm.; length of hind wings, male 17, female 17-18.5 mm.; width of hind wings, male 3.25, female 3 mm.

Connecticut.—Guilford (Pistapaug Pond), 27 July, 1920 (P. G.).

New England.—June 19-August 19.

Group 5

Enallagma durum Hagen

Synopsis of the Neuroptera of North America, 87: 1861.

Nymph.—Mental setae 3, laterals 4. Lateral keels of the abdomen sparsely setose, the setae not rounded conspicuously at the apices; gills long and narrow (Pl. 1, Fig. 11), thickly provided with tracheae and having a brownish tint along the axis.

Measurements: length of gills, about 7.5 mm.; width, 1.5 mm.

Described from one nymph obtained from Howe and several others, identified by comparison, obtained at East Haven, Conn.

Adult, male.—Color blue or buff (teneral) and black.

Head: labium buff; labrum, mandibles, genae, anteclypeus, cephalic margin of the postclypeus, and the front dorsad of the clypeus to the antennal fossae, blue or pale; vertex black; post-ocular spots cuneiform, connected with the postocellar pale stripe; occiput and postgenae pale.

Thorax: pronotum black, the cephalic lobe largely blue, large lateral spots on the median lobes and the caudal margin, which are also blue; mesostigmal plates triangular, the lateral angles and caudal margins blue; dorsal carina blue, bordered on each side by broad black stripes occupying half the anepisterna; pale stripe of the anepisterna very little broader over the katapisterna,

the margins nearly parallel; black stripes of the mesopleural suture widest adjacent to the katepisterna and a little contracted just cephalad of the wing bases; remainder of the thorax blue, except small spots on the metapleural sutures adjacent to the wing bases; legs blue, including coxae and trochanters, the dorsum of the femora black, the tibiae with a black stripe on each which includes the cephalo-ventral row of setae; tarsi and claws pale, darker at tips; wings with 11-13 postnodals in the front wing and M_1 arising between 5 and 6; there are three cross-veins between M_1 and Cu_1 , proximad of the nodus, and this species differs in this respect from all other *Enallagmas*.

Abdomen: blue and black; dorsum of tergum 1 black at base; terga 2 black above, 3, 4, and 5 with an apical ring and spot, the spot on each extending cephalad and contracted to a line on the meson; a little more than half the dorsum of 6, and all of 7 except a basal ring, black; terga 8, 9 and 10 blue except the dorsum of 10, which is black; superior anal appendages (Fig. 10, No. 18) blunt, shorter than the inferiors, with short dorso-lateral tubercles and a pale rounded tubercle on the ventro-mesal angles; inferiors blue with black tips, the tips slender and acute.

Female.—Color darker than the male.

Head and thorax similar to the male, but the abdomen differs in having the dorsum of terga 1-8 with black from bases to apices; terminal segments obscurely marked in some specimens. Mesostigmal plates as in Fig. 11, No. 7.

Measurements: length, male 38, female 38 mm.; length of abdomen, male 30, female 29 mm.; length of hind wings, male 20-21, female 22 mm.; width of hind wing, male 4-4.5, female 4.5 mm.

Connecticut.—Woodmont, 23 July, 1904; Branford, 20 July, 1904 (P. L. B.); North Haven, 10 August, 1921 (W. E. B.) (P. G.); New London, 7-15 June, 1921 (R. H. H.).

New England.—July 23-August 25.

Group 6

Enallagma aspersum (Hagen)

Synopsis of the Neuroptera of North America, 97: 1861.

Nymph.—Unknown.

Adult, male.—Color blue and black.

Head: blue and black; antennae black; postclypeus black, the cephalic margin sometimes blue; anteclypeus and labrum brown or buff and blue, the front blue above the clypeus to the base of the antennae; remainder of the front and vertex black; post-ocular spots blue, the blue connected with the blue of the occiput and postgenae.

Thorax: blue and black; pronotum black except the narrow

cephalic lobe, and in some specimens a small blue spot on each side on the median lobes, caudal margin also blue; proepimera black above, pale or blue below; mesostigmal plates about half blue. Mesothorax with a broad dorsal stripe, covering the carina and also half of the mesanepisterna on either side; this is followed by a blue stripe which occupies most of the remaining portion of the anepisterna of the mesothorax; mesopleural suture covered with a black stripe which is considerably widened near the caudal margin of the katepisternum and extends over that sclerite covering the dorsal half or third; remainder of the thorax blue or buff; legs black and buff, the coxae and trochanters pale, the femora with a dorsal black stripe including one row of setae; tarsi and claws black, shining; front wings with 9-11 postnodal cross-veins, and M_2 arising between the fourth and sixth of these, usually near the fifth.

Abdomen: blue and black; a basal spot on the first, a dorsal apical spot and ring on the second, apical three-fourths of the dorsum of the third, dorsum of 4, all of 5 and 6 except narrow basal rings and lateral margins, cephalic half of 7, and all of the dorsum of 10 are black; caudal half of 7, all of 8 and 9, and sides of 10 blue; there is some variation in the amount of blue on the proximal segments; anal appendages black, the superiors longer than the inferiors and with a ventral basal tubercle (Fig. 10, No. 2), the apices blunt and directed ventrad; inferiors conical, sharply pointed, and directed obliquely dorsad, about half as long as the superiors.

Female.—Color similar to the male.

Head: with postocular spots sometimes separated from the blue of the occiput.

Thorax: mesostigmal plates black.

Abdomen (Fig. 11, No. 20): with terga 1-6 as in male, 7 with a dorsal stripe reduced to a mesal line on the basal three-fourths but suddenly widened at the apex; eighth tergum black, with two basal spots connecting with the pale lateral margins; dorsum of 9 and 10 black.

Measurements: total length, male 27-32, female 30-34 mm.; length of abdomen, male 22-25, female 23-26 mm.; length of hind wings, male 16-18, female 18-20 mm.; width of hind wings, male 3-3.7, female 3.5-4 mm.

Connecticut.—Branford, 21 July, 1920 (P. G.); Ellington, 8 July, 1926 (J. L. R.).

Genus *Argia* Rambur

Nymphs.—Caudo-lateral margins of the head not angulate; labium without mental setae; abdomen without spinulose lateral keels; gills half as broad as long, with cuticular pigment, the

tracheae more or less obscured; gills usually with blunt points; length including gills 15-20 mm.

Adults.—Head with or without postocular spots; wings with 12 or more postnodal cross-veins; M_2 arising between the fifth and ninth postnodal; width of stigma between C and R not greater than its length; stigma of male not remote from margin; dorsum of thorax with more or less brown or black, never entirely metallic green, the caudal margin of female prothorax entire; tibial setae longer than the intervals between their bases; mesopleural suture usually with a black stripe immediately below; abdominal terga 1-6 never red or yellow, usually black with median stripes of brown or purple, or entirely black with pale basal rings; female without a ventral spine on segment 8.

The *Argias* seem to be well differentiated in their habits at least as far as Connecticut species are concerned. *Violacea* and *translata* are pond and small-lake species, and the nymphs may be found around the borders of such ponds. The only place where *translata* has been found is a small reservoir supplying the town of Wallingford, the adults being taken along the east shore, at the base of a high hill which rises directly out of the water. The entire east side of the lake is protected, and there is another hill protecting the north end, the elevation of the pond itself being about 300 feet. *Moesta* is a swift-stream species and is most frequently found near such places. The eggs of all species are probably laid in dead plants or wood near the edge of the water.

For literature dealing with adults, consult:

Calvert, P. P. *Biologia Centrali Americana*, pages 69-72: 1901.
Also works of Garman (1917), Howe (1912), Kellicott (1899), Needham (1903), and Williamson (1899). (See appended list.)

For literature dealing with the nymphs, see:

Needham, J. G. Bulletin 68, New York State Museum, pages 237-245: 1903.

Garman, P. Bulletin of the Illinois State Laboratory of Natural History, XII, 501-517: 1917.

Howe, R. H. Memoir of the Thoreau Museum of Natural History, II, page 110: 1921.

Key to Species

Nymphs

1. Labial palpi with a single weak seta on the proximal segment; gills broad at the tip, the margins parallel for a considerable distance; without light cross-bands and not coarsely spotted .. **moesta**
- Labial palpi with two or more setae on the proximal segment; gills not with parallel margins, and usually coarsely spotted with pigment 2
2. Gills broadest beyond the middle, decidedly ovate, sharply pointed and frequently with a V-shaped clear area near the apex .. **violacea**
- Gills not broadest beyond the middle nor sharply pointed at tips .. **translata**

Adults, Males

1. Wings smoky (*fumipennis*)
Wings clear 2
2. Stigma surmounting more than one cell in both wings *moesta*
Stigma surmounting one cell or less in both wings 3
3. Proximal segments of the abdomen purplish or reddish violet *violacea*
Proximal segments of the abdomen never with purplish or reddish violet 4
4. Proximal segments of the abdomen mostly pale blue with dark apical rings *bipunctulata*
Proximal segments of the abdomen either entirely black with narrow apical pale rings or with longitudinal stripes of dark color on either side of each segment. 5
5. Dorsum of the mesothorax mostly pale; dorsal stripe covering the carina reduced to a line (*apicalis*)
Dorsum of the mesothorax mostly black, or with a broad black stripe on the dorsal carina 6
6. Dorsum of the thorax nearly or entirely black; segments 8 and 9 of the abdomen black *translata*
Dorsum of the thorax with some paler marks; segments 8 and 9 blue 7
7. Ventral arm of each inferior anal appendage exceeding the dorsal arm considerably *sedula*
Ventral arm of each inferior appendage not exceeding the dorsal arm in length (*tibialis*)

Females

1. Wings smoky (*fumipennis*)
Wings clear 2
2. Thorax with a broad black stripe ventrad of the mesopleural suture 5
Thorax without a broad black stripe ventrad of the mesopleural suture 3
3. Mesostigmal plates with a sharp median caudal projection (Fig. 11, No. 15); stigma surmounting more than one cell in both wings *moesta*
Mesostigmal plates without a sharp median projection; stigma surmounting one cell or less in both wings 4
4. Front vertex and occiput wholly brown; caudal margins of the mesostigmal plates forming a thin blade which projects dorsad *sedula*
Front vertex and occiput not wholly brown; caudal margins of the mesostigmal plates not forming a thin blade which projects dorsad (*apicalis*)
5. Mesostigmal plates each with a rounded lobe at the mesal angle (Fig. 11, No. 16) 6
Mesostigmal plates each without a rounded lobe at the mesal angle 7
6. Terga 1-5 with a pale mid-dorsal stripe much broader than the black stripes on either side, the latter sometimes wanting or reduced to apical spots *violacea*
Terga 1-5 with the pale mid-dorsal stripe not so wide as the black stripes on either side *translata*
7. Dorsum of the eighth tergum only, pale; black stripe below the mesopleural suture reaching the wing bases, and in contact with the suture for its entire length *bipunctulata*
Dorsum of segments 8 and 9 black or dark brown; stripe below the mesopleural suture not reaching the wing bases and separating from the suture near its caudal end (*tibialis*)

***Argia bipunctulata* (Hagen)**

Synopsis of the Neuroptera of North America, 90: 1861.

Nymph.—Unknown.

Adult, male.—Color very light blue and black.

Head: labrum blue with mesal spot on the caudal margin; clypeus blue with a black spot on each side of the postclypeus; genae and front to the antennae blue; vertex black with pale post-ocellar stripe and a small spot cephalo-laterad of each lateral ocellus; rear of head black on each side of the occipital foramen, pale next the eyes and above.

Thorax: pronotum black; median lobe with a spot on each side near the lateral margin, the lateral angles of the caudal lobe also pale, propleura mostly pale; mesothorax with a narrow pale stripe on the mesepisternum, the stripe about half as wide as the black stripe below the mesopleural suture; metapleural suture lined with black and with a spot near wing bases; remainder of pleura and sterna pale; legs with pale dorsal carina on the femora, the latter largely black above; tibiae black or brown below, pale above; tarsi and claws dark brown to black; wings with stigma surmounting a single cell, and M_2 arising between the fifth and sixth postnodal cross-vein in the front wings and between the fourth and fifth in the hind.

Abdomen: tergum 1 pale, black at base; 2 blue, with two dorsal spots near the caudal margin and an apical ring black; 3 blue, with caudal fourth black, the black surrounding a small pale spot on each side, 4 and 5 blue, with caudal third black; 6 and 7 black, with blue basal spots; 8, 9 and 10 blue, 10 with brown in the sides; anal appendages dark brown, the superiors entire, inferiors with ventral arm hardly longer than the dorsal, the ventral pale at tip; a pale-blue bifurcate process between the superiors.

Female.—Blue color replaced by yellow, darker than the male in general appearance.

Thorax: with the black stripe below the mesopleural suture continuing to the wing bases, not separating from the suture near the caudal end as in *apicalis*.

Abdomen: terga mostly black; 1 and 2 with sides pale; 3 and 4 with lateral pale stripes about three-fourths the length of the segment, the black of the dorsum extending to the lateral margins at the apex of each and enclosing there a small yellow spot; 5 with basal ring and lateral basal pale stripes half the length of the segment; 6 and 7 black with pale basal rings; 8 pale above, black on the sides; 9 and 10 entirely black.

Measurements: total length, male 26, female 28 mm.; length of abdomen, male 21, female 22 mm.; length of hind wings, male 14-15, female 16 mm.

This species has not been taken in Connecticut, but occurs in New Jersey and Maryland. It is a striking form, very different from other *Argia* species, the male resembling an *Enallagma* strongly in color and size.

Described from specimens received through the kindness of William T. Davis.

Argia moesta (Hagen)

Synopsis of the Neuroptera of North America, 94: 1861.

Nymph.—Color dark brown.

Head: broad and flat, pentagonal, the caudo-lateral margins projecting and with a few short setae; antennal segments dark except the first, which is pale; labium, with slightly narrowed median lobe, the apical margin projecting strongly between the palpi; mental setae absent; lateral marginal setae, about 12 in number; palpi with two fixed hooks on the proximal segment; setae of the palpi reduced to a single weak hair.

Thorax: brown; pronotum projecting strongly laterad; legs not conspicuously banded but the femora with a faint preapical ring and the proximal two-thirds evenly infuscated; tibiae with dark spines, tarsi mostly pale; wing-cases extending to the middle of the fourth abdominal segment or beyond.

Abdomen: uniform brown, the lateral keels feebly developed and without spines; styli of the male long, nearly reaching the apex of the tenth segment; apical margin of 10 cleft nearly to its base; gills uniform dark gray or nearly black, paler at the tip, the margins parallel for a considerable distance.

Measurements (young nymphs): length, 14 mm.; length of abdomen, 9 mm.; length of gills, 5-6 mm.; width of gills, 3 mm.; length of metathoracic wing-cases, 4 mm.

Adult, male.—Color, black and cinnamon-buff, older specimens pollinose.

Head: very dark brown above, shading into a lighter brown on the labrum and surrounding parts; postclypeus with two indefinite dark spots; black of the vertex often indefinite in extent, and the whole dorsum of the head pollinose in older specimens.

Thorax: pronotum dark brown with large pale spots on each median lobe, the prothorax pollinose on the sides; dorsal carina of the mesothorax usually black, and the black of the episterna occupying about half the width of each; mesopleural suture black; mesepimerum nearly covered with black or dark brown, the stripe separated from the mesopleural suture caudad; cephalic shoulders of mesepimera brown; metapleural suture black; remainder of thorax brown; the whole of the meso- and metathorax becomes pollinose, especially the dorsum; legs striped, tarsi and claws black; wings clear, with 15-19 postnodal cross-veins in the front

wing; stigma surmounting one and one-half to two cells; M_2 arising between the sixth and ninth postnodal in the front wing and between the fifth and eighth in the hind.

Abdomen: black (sometimes greenish) with pale basal rings on segments 3-7 inclusive; last two segments become pollinose; anal appendages (Fig. 12, No. 20) consisting of short club-like superiors, and broad inferiors.

Female.—Color light blue or olive, buff and black.

Head: front genae and vertex pale blue or buff, the vertex with indefinite black areas around the ocelli.

Thorax: usually brown, sometimes blue; mesostigmal plates (Fig. 11, No. 15) each with a short median somewhat acute process projecting caudad over the cephalic margin of the episterna; mesepisterna and mesepimera without the broad dark stripes of the male.

Abdomen: black and blue or brown, the dorsum of terga 1-9 frequently with brown stripes.

Measurements: total length, male 37-42, female 38-41 mm.; length of abdomen, male 28-33, female 29-32 mm.; length of hind wings, male 23-26; female 25-26 mm.; width of hind wings, male 4.5-5.5, female 4.5-5.5 mm.

Connecticut.—Putnam, 12 July, 1905 (H. L. V.); Shelton, 9 July, 1920; Stratford, 9 July 1920 (P. G.); Litchfield, 6 July, 1913, 25 July, 1914, 16 July, 1916 (L. B. W.).

New England.—June 16-August 30.

***Argia translata* Hagen**

Bulletin de l'Academie royale . . . de Belgique (2), 20: 410: 1865.

Nymph.—Color dark brown.

Head: antennal segments brown; lateral and mental setae wanting; median lobe projecting strongly between the palpi.

Thorax: legs with two femoral and three tibial brownish rings; wing-cases extending to about segment 4 in exuviae.

Abdomen: with a pale dorsal longitudinal stripe, the cuticle brown and with few setae; gills uniform dark brown, coarsely granular when magnified; some with a paler band at middle as in *tibialis* or *apicalis*.

Measurements: length of gills, 4-4.5 mm.; width, 1-1.5 mm.; length of median lobe, 3 mm.

The nymph differs from *moesta* and *violacea* in having three broad, dark tibial bands, being similar in this respect to *tibialis* and *apicalis*. The gills are uniform brown and considerably narrower than other species. Described from four exuviae obtained at Pistapaug Pond July 8, 1921; no other *Argias* were found at this pond and the exuviae, therefore, were assumed to be that of *translata*.

Adult, male.—Color black and brown.

Head: almost entirely black in older specimens, marked with brown in younger; postocular spots subcircular, brown or bluish; setae of labium, clypeus and front long and black or very dark; genae, mandibles, occiput and postgenae, brown in teneral, black or pollinose in others.

Thorax: pronotum uniformly dark, the caudal lamina thin, unbroken, and projecting dorsad; pleura and sterna light in color; dorsum of meso- and metathorax entirely black in older specimens, the sides and venter pollinose, legs also black except the dorsal surface of the tibiae; teneral have a pale dorsal carina flanked on either side by a broad dark stripe; mesopleura each with two pale stripes, one above and one below the mesopleural suture; legs mostly dark brown; front wings with 14-15 postnodal cross-veins, M_2 arising between 6 and 8; stigma usually surmounting one cell.

Abdomen: black or very dark, segment 1 with dorso-apical and lateral apical yellow spots; 2 with lateral stripe and dorsal exclamation mark; all marks on first and second terga obscured with pollen in older individuals; tergum 3-5 with narrow basal ring and lateral stripes; 6-8 black with basal rings only; 8 with a broad lateral spot on each side at base, the two connected in some individuals; terga 10 mostly dark in color; anal appendages (Fig. 12, Nos. 18 and 19) dark. In older specimens the abdomen appears entirely black, with narrow basal rings on 3-8; anal appendages black, superiors decurved, inferiors with a ventral extended lobe.

Adult, female.—Color similar to the male; postocular and postocellar spots present, and the pale area of the front above clypeus is divided by a dark line on the meson.

Thorax: similar in color to the male; the pale stripe above and below the mesopleural suture much more conspicuous than in the male; mesostigmal plates (Fig. 11, No. 14) with a large rounded lobe on caudo-mesal angles; abdomen with a pale median dorsal line in younger specimens, and lateral, usually interrupted stripes on 2-6 and 8-9; 10 pale on sides.

Measurements: total length, male 34-36, female 32-33 mm.; length of abdomen, male 27-33, female 25-29 mm.; length of hind wings, male 18.5-23, female 20-23 mm.; width of hind wings, male 4-4.5, female 4.5 mm.

Connecticut.—North Guilford (Pistapaug Pond), 27 July, 1920, 8 July, 1921 (P. G.).

***Argia violacea* (Hagen)**

Synopsis of the Neuroptera of North America, 90: 1861.

Nymph.—Color very dark brown.

Head: proximal segment of the antennae light in color; labium with two or three lateral setae on the palpi; the median lobe about

two-thirds as long as broad; palpi with simple hooks besides the movable distal segment.

Thorax: dark brown; legs with coxae and trochanters dark, the femora with fuscous bases and apices and usually two broad rings in addition; tibiae dark brown at base and apex, and a ring just proximad of the middle; tarsi dark.

Abdomen: dark brown with a pale mesal stripe; lateral keels feebly developed and without or with minute setae; gills ovate, uniform dark brown, or sometimes having a V-shaped mark on each near the apex; ovipositor of the female extending to apex of the tenth abdominal segment or beyond.

Measurements: length (with gills), 17 mm.; length of abdomen, 7 mm.; length of gills, 4.5-5 mm.; width of gills, 2-2.5 mm.; length of median lobe, 1-2 mm.

Adult, male.—Color dark brown or purple.

Head: antennae with the basal segment and sometimes the proximal end of the second segment buff, remainder black; clypeus and labrum pale brown, the front, vertex and postocular regions also largely pale but becoming violet with age, the black confined to a broad transverse band embracing the lateral ocelli, a T-shaped mark ventrad of the median ocellus and narrow lines extending from the ends of the transverse band to the compound eyes and to the caudal margins of the head; caudo-dorsal margins of the head with a black line.

Thorax: brown or violet, and black, median lobe of the pronotum with large brown or purple spots; dorsal carina black, the stripe on each side about one-third the width of the anepisterna; a black stripe present just below the mesopleural suture, the stripe contiguous with the cephalic half of the longitudinal part of suture; metapleural suture lined with black; metepimera and postcoxal areas buff, legs striped, tarsi and claws black; wings clear, the stigma surmounting a single cell or less; postnodal cross-veins of the front wing 11-15, and M_2 arising between the fifth and seventh of these.

Abdomen: purple and black or brown and black; basal half of first tergum black; second tergum with lateral spots extending from cephalic margin nearly to apex of the segment; 3 and 4 brown or purple, with exception of a caudo-lateral dark spot on either side; terga 5 and 6 with a dark apical ring and sometimes narrow lateral black stripes; 7 black, 8, 9 and 10 blue on dorsum, black on lateral surfaces; anal appendages (Fig. 12, No. 16) consisting of short blunt superiors and longer inferiors.

Female.—Color dark brown or dull violet.

Head: similar to the male.

Thorax: mesostigmal plates with rounded lobes on the caudo-mesal angles (Fig. 11, No. 16); abdomen with more black than the male; terga 2-9 with dorso-lateral dark stripes which are

broad enough on the seventh and eighth terga to fuse on the meson, though sometimes interrupted on the various segments, forming a series of exclamation marks; lateral surface of tergum 9 and all of 10 buff.

Measurements: total length, male 32, female 31-33 mm.; length of abdomen, male 24-27, female 24-26 mm.; length of hind wings, male 20, female 20-22 mm.; width of hind wings, male 4, female 5 mm.

Connecticut.—Orange, 21 July, 1905 (W. E. B.); Portland, 8 August, 1913 (B. H. W.); Guilford, 13 July, 1920; Twin Lakes, 20 August, 1921; Hamden, 3 August, 1920 (P. G.); New London, 8-22 June, 1921 (R. H. H.).

New England.—June 6-September 26.

The species *tibialis* and *apicalis* do not occur in New England, but may be distinguished from the species herein described by the following: Nymphs of *tibialis* and *apicalis* have long ovate gills coarsely spotted with dark pigment and usually with a pale transverse stripe. Female adults of *tibialis* and *apicalis* are characterized by the lack of caudal projections on the mesostigmal plates (*tibialis*) or a very short pointed projection at the caudo-mesal angles (*apicalis*). The males are not easily distinguished, but differ in the anal appendages and color of the thorax and abdomen. *Tibialis* is perhaps most closely related to *translata*, but may be distinguished by the greater amount of pale color on the sides of the thorax and the different anal appendages. *Apicalis* is a much lighter colored species than *translata* and possesses considerable blue pigment.

Argia fumipennis is a southern species with clouded wings.

Subfamily LESTINAE Needham

The nymphs have long slender bodies and are furnished with characteristic gills (Pl. I, Figs. 1-6). The mentum is frequently contracted at the proximal end, much more so than in the Coenagrioninae.

This family is represented in Connecticut by a single genus, *Lestes*. In addition to characters stated in the key, the presence of long tibial spines, which are much longer than the intervals between their bases, is important. Only two other genera are known from the United States, one of which is tropical in its distribution, the other occurring in the Rockies and far west.

The different members of the genus *Lestes*, the only representative of the subfamily, are all pond or small-lake species and their nymphs may be found often in considerable abundance among the weeds bordering these places. The adults of the species with brown thoraces such as *forcipatus* and *disjunctus*, are frequently of retiring habit and well protected by their coloration. The adults of the brighter species such as *inaequalis*, *uncatus* and *vigilax*, however, love the open and may be found skimming near the

surface of ponds and alighting on lily pads or other plants. It is reported that the eggs are laid in plants above the surface of the water.

Genus **Lestes** Leach

The nymphs are characterized by the form of the labial palpus, which is represented in Fig. 7, No. 4, and by the figuration of the gills (Pl. I, Figs. 1-6). They are extremely active insects when disturbed, but usually remain quiet and are hidden perfectly by form and color when in their natural environment.

The adults of the genus comprise mostly dull-colored species of elongate form and retiring habit. They are found frequently along the edges of woodland pools where they are inconspicuous because of their protective coloration. The wings of the adult possess numerous pentagonal and some hexagonal cells; and M_2 always arises several cells beyond the subnodus.

For literature on the adults of *Lestes*, see:

Selys, E. de, *Revue d'Odonata*, 1850, page 146.

——— *Bulletin de l'Academie royale . . . de Belgique*, 16: 210: 1862.

Also general works of Calvert (1893); Howe (1917); Garman (1917); Kellicott (1899); Williamson (1900).

For literature dealing with nymphs, see:

Garman, P. *Bulletin of the Illinois State Laboratory of Natural History*, XII: 477-499: 1917.

Howe, R. H. *Memoirs of the Thoreau Museum of Natural History*, II: 107-109: 1921.

Needham, J. G. *New York State Museum Bulletin* 68: 228-236: 1903.

Walker, E. M. *Canadian Entomologist*, 46: 189-200, 349-350: 1914, Plates 13, 14, 23.

Key to Species

Nymphs

1. Distal segment of the labial palpus with three setae; labium broad at the proximal end, the contracted portion of the median lobe hardly longer than the expanded portion and about one-third as broad **congener**
- Distal segment of the labial palpus with only two setae or rarely three (*uncatus*); labium narrow at the proximal end, the contracted portion much longer than the expanded portion and less than one-third the width of the latter 2
2. Lateral gills tapering to sharp points; venter of abdomen without a median row of black spots 3
- Lateral gills not sharply pointed; venter of abdomen usually with a median row of black spots 4
3. Ovipositor of female extending beyond the proximal segment of the gills; lateral gills not; distal segment of the palpus with three setae **uncatus**
- Ovipositor of female not extending beyond the proximal segment of the gills; distal segment of the palpus with two setae **unguiculatus**
4. Lateral keels of segments 1-9 or 2-9 with long apical spines; gills about equal in width throughout, not usually narrowed beyond the middle **vigilax**

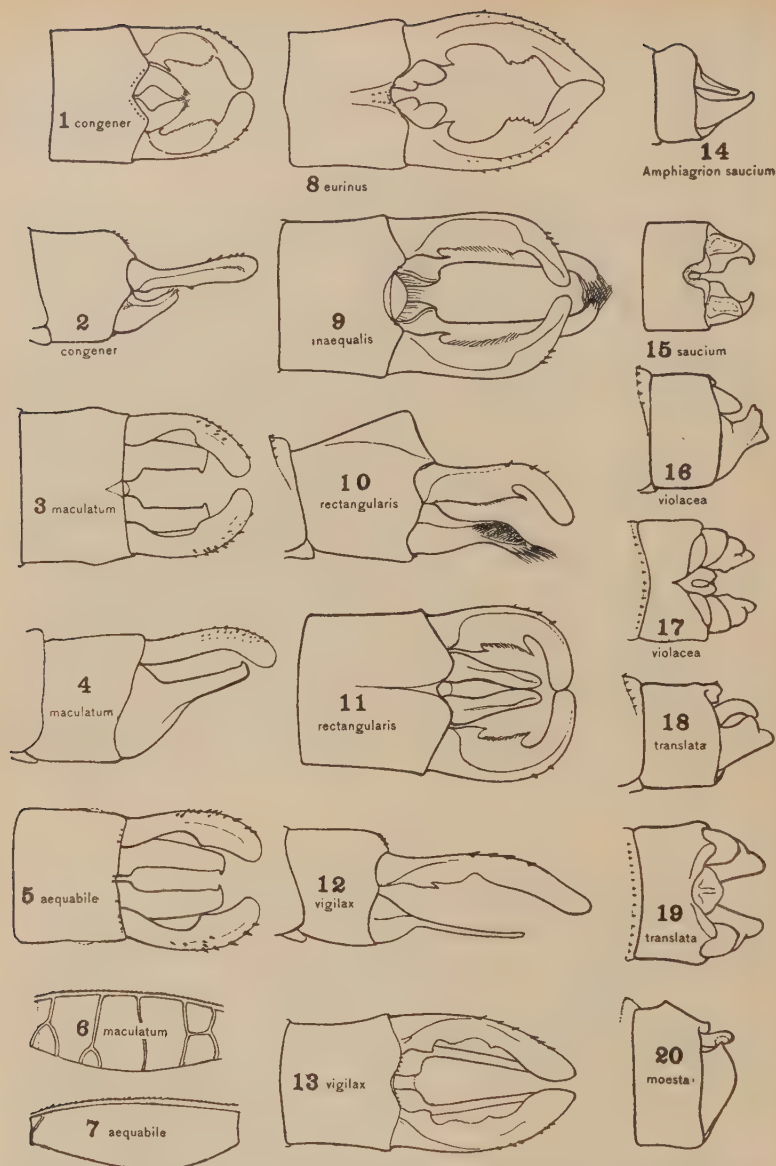


FIG. 12. Anal appendages of *Lestes*, *Agrion*, *Argia*, and *Amphiagrion*; pterostigma of *Agrion*. 1. *Lestes congener*, dorsal view of anal appendages. 2. *L. congener*, lateral view. 3 and 4. *Agrion maculatum*. 5. *A. aequabile*. 6. *A. maculatum*, pterostigma of front wing of female. 7. Same of *A. aequabile*. 8. *Lestes eurinus*, anal appendages from above. 9. *L. inaequalis*. 10 and 11. *L. rectangularis*. 12 and 13. *L. vigilax*. 14 and 15. *Amphiagrion saucium*. 16 and 17. *Argia violacea*. 18 and 19. *A. translata*. 20. *A. moesta*.

Metepimera without a black spot above and below the latero-ventral carinae	6
6. Ovipositor extending about as far beyond the tip of segment 10 as the ventral length of that segment—considerably beyond the ventral anal appendage	forcipatus
Ovipositor not extending as far beyond the tip of segment 10	7
7. Occiput and postgenae mostly pale	unguiculatus
Occiput and postgenae black or dark	8
8. Tarsi black above; abdomen less than 30 mm. long	disjunctus
Tarsi pale above; abdomen more than 30 mm. long	rectangularis

Lestes congener Hagen

Synopsis of the Neuroptera of North America, 67: 1861.

Nymph.—Color pale brown or greenish.

Head: labium with the median lobe comparatively broad at base, the contracted portion one-third as broad as the expanded and about as long; mental setae usually 6, sometimes a small seventh on each side; lateral setae four or five; labium when folded extending between the metacoxae.

Thorax: distances between pro- and mesocoxae, and between meso- and metacoxae about equal; all femora with faint preapical brown rings; wing-cases hardly extending caudad of the second abdominal segment.

Abdomen: with poorly developed lateral keels, which are provided with apical spines on segments 5-9; gills broad, bluntly pointed and with three cross-bands of dark pigment (Pl. I, Fig. 3); ovipositor of the female reaching slightly beyond the apex of the tenth segment.

Measurements: length, 16 mm.; length of abdomen, 12 mm.; length of gills, 8 mm.; width of gills, 2 mm.; length of meta-thoracic wing-cases, 5 mm.; length of median lobe, 3 mm.

Adult, male.—Color dull brown and buff or yellow.

Head: black, buff below; postclypeus black or dark brown, the anteclypeus, labrum, and genae, to the level of the fronto-clypeal suture, yellow; lateral ocelli sometimes with small yellow spots alongside; front, remainder of the vertex, occiput, except occasionally a transverse yellow stripe from the occipital foramen to the compound eyes, black; eyes blue.

Thorax: dark brown and yellowish buff, the prothorax dark brown, the median lobes of the pronotum with pale lateral margins and mesal spots near the caudal margin, the black areas spreading with age and occupying most of the lobes; caudal lobe and propimera black or dark brown; dorsal carina usually with a pale line, the mesepisterna except the ventral half of the katapisternum black or dark brown, usually with a greenish tinge; caudo-dorsal angle of metepisterna dark brown or black; metepimera each with an elongate black spot near the ventro-lateral carina (sometimes two spots) and a similar spot just below the carina; legs striped,

the coxae buff, trochanters black above, the femora black, with a narrow pale stripe including the cephalo-ventral row of setae, and a broad dorsal stripe frequently divided by a faint row of spots; tibiae yellow, with a dark stripe including the cephalo-ventral row of setae; tarsi and claws black; wings clear, 9-11 postnodals in the front and 8-10 in the hind wings; stigma brown surmounting one and one-half to two and one-half cells; M_2 arising between the third and fourth postnodal cross-vein in the front wing, and between the second and third in the hind.

Abdomen: black and buff; terga 1-10 with broad dorsal brown or black stripes, the lateral margins with broad pale stripes, the pale color extending well to the dorso-meson in basal rings on segments 3-7 inclusive; first tergum with a dark spot near latero-ventral margins, anal appendages black (Fig. 12, Nos. 1 and 2) and reddish, the superiors depressed, the ventro-mesal margins with large sub-basal teeth and setae beyond these to the apical third; inferiors usually less than half the length of the superiors, bluntly rounded, with a fine brush of silken hairs at tips.

Female.—Color similar to the male.

Head and thorax: similar to the male.

Abdomen: interrupted basal rings on terga 3-6 inclusive, the lateral stripes broader than those of the male; ovipositor black along the ventral margins; styli dark, and nearly straight; ventral margins of ninth tergum black immediately above the ovipositor.

Measurements: total length, male 34-35, female 32-36 mm.; length of abdomen, male 26-28, female 24-29 mm.; length of hind wings, male 17-20, female 19-22 mm.; width of hind wings, male 3.5-4, female 4 mm.

Connecticut.—Branford, 3 September, 1904 (H. L. V.); Westville, 4 July, 1905 (W. E. B.); New Canaan, 10 September, 1919 (P. G.); Hamden, 3 August, 1920 (P. G.); Litchfield, 19 August, 1917 (L. B. W.).

***Lestes disjunctus* Selys**

Bulletin de l'Academie royale . . . de Belgique, 16: 210: 1862.

Adult, male.—Color blackish brown and yellow.

Head: blackish brown above, pale below; antennae black; postclypeus black; anteclypeus, labrum, trochantins of the mandibles and genae yellowish green. Occipital and postgenal regions black or metallic, becoming pollinose with age; eyes brown.

Thorax: prothorax black, pollinose in older specimens; mesostigmal plates usually black; mesokatepisterna largely or entirely black; mesopleural pale stripe, little narrowed at the caudal end, reduced to two-thirds its width in front; shoulders of the mesepimera yellow; metepisterna largely yellow, becoming more or less black with age from the spreading of the black stripe on the metapleural suture; stripes of the metapleural sutures covering about two-thirds of the metepimerum, the remainder of that sclerite

yellow, post-coxal areas buff without black marks; femora striped, tibiae with a single dark stripe which covers the segment distally; wings clear; postnodals 11-14 and M_2 usually arising between the second and third postnodal in each wing; stigma surmounting two cells.

Abdomen: brown to black (sometimes with a greenish tint) and yellow; dorsum of terga 1-7 more or less dark in color, the lateral margins pale, terga 8-10 black; anal appendages blackish brown, the superiors with spinose lateral surfaces, the mesal margins having two nearly equal teeth; inferiors flat, placed horizontally and slightly swollen at the base and apex.

Female.—Color similar to the male.

Head: similar to the male.

Thorax: without the black mark on the metapleural suture, and the mesokatepisternum largely pale.

Abdomen: the brown of the terga more confined to the dorsal surfaces, the lateral surfaces mostly yellow; ovipositor extending to or well beyond the apex of segment 10.

Measurements: total length, male 32-37, female 35-37 mm.; length of abdomen, male 25-30, female 27-28 mm.; length of hind wings, male 17-20, female 19-22 mm.; width of hind wings, male 4-4.5, female 4.5 mm.

Older males are sufficiently characterized by the black mark on the metapleural suture, but this may be wanting in younger individuals and in the female. The pale stripe of the mesopleural suture is not usually contracted caudad as in *forcipatus* and *rectangularis*, the nearest allies. Pl. 1, Fig. 5 shows a tracheal gill of a nymph obtained from Dr. Howe.

Connecticut.—West Thompson, 12 July, 1905 (H. L. V.).

New England.—June 21-September 23.

Lestes eurinus Say

Journal of the Academy of Natural Sciences of Philadelphia, 8: 36: 1839.

Nymph.—Gills similar in shape to *L. vigilax* (Pl. 1, Fig. 4); lateral keels with apical spines on 3-9; mental setae 5, laterals 3; mentum narrow at base; teeth of the distal margin of median lobe truncate at apices.

Measurements: length of gills, 9.5 mm.; width of gills, about 1.5 mm.

Adult, male.—Color metallic green and yellowish buff.

Head: metallic green; mouth parts buff; postclypeus black; anteclypeus, exposed portions of the mandibles, and genae, brown or greenish yellow; front, vertex, and all of the occiput and post-genae, metallic green or black; eyes dark brown.

Thorax: metallic green and buff; pronotum metallic green, sometimes pollinose, the caudal and cephalic lobes black with age;

mesostigmal plates black; dorsal carina brown, the mesanepisternum metallic green; mesopleural suture brownish, the dorsal half of the mesokatepisterna black; mesepimera black or green, the dark color sometimes extending onto the metepisterna or epimera; remainder of the metapleura and metasternum yellow, sometimes pollinose and obscurely marked with black; legs with striped femora and tibiae, the tarsi and claws dark brown, the latter deeply notched; wings usually flavescent and with 13-15 postnodal cross-veins in the front wing and 12-15 in the hind. M_2 arising between the third and fourth postnodal in the front and between the second and third in the hind; stigma surmounting two and one-half to three and one-half cells in both wings.

Abdomen: metallic green and black and buff; dorsum or terga 1-8 inclusive green, their lateral margins buff; terminal sterna pollinose with age; anal appendages (Fig. 12, No. 8) black, the superiors long and curved, with lateral surfaces coarsely tuberculate or spinose, the meso-ventral margins of each with a single sharp basal tooth and a submedian projection which has several smaller teeth; inferiors blunt, very short, and each with a brush of fine setae.

Female.—Color metallic green and yellow and black.

Head: similar to the male.

Thorax: mesothorax with a broad, brownish or blackish stripe covering the dorsal carina, and a green longitudinal stripe in the middle of each anepisternum; mesopleural suture with a broad brownish or blackish stripe which extends across the katepisternum; metepimera with indefinite brown oblique stripe, the remainder usually yellow; stigma surmounting as many as four cells in both wings.

Abdomen: ovipositor with broad black or nearly black lateral valves, the ventral margins finely toothed and the valves separated from the tenth segment by a considerable interval; eighth sternites large and black, caudo-dorsal angles rounded.

Measurements: total length, male 48-51, female 47-49 mm.; length of abdomen, male 36-40, female 36-37 mm.; length of hind wings, male 28-30, female 28-31 mm.; width of hind wings, male 5.5-6.5, female 5.5-6 mm.

This species is most closely related to *vigilax* and *inaequalis*, but is more robust and the wings are noticeably flavescent.

Connecticut.—East Haven, 21 July, 1920 (P. G.).

New England.—June 1-July 21.

***Lestes forcipatus* Rambur**

Histoire naturelle des insectes. Neuroptères, 246: 1842.

Nymph.—Color buff or green.

Head: brown and buff; labium when folded extending caudad

of the mesocoxae, not usually reaching the metacoxae; mental setae 5-6, laterals 3.

Thorax: about as long as broad, brown; legs slender, femora all with subapical rings and several rows of setae; tibiae with dark brown apices; tarsi with apical half or more of the last segment, also the claws, dark brown; metathoracic wing-cases extending to the middle of the third abdominal segment.

Abdomen: lateral keels with apical spines on segments 5-9; terga darker than sterna, the venter with a dark line beneath each lateral keel, two spots at apex of 3-8 or 1-8; sternum of segment 10 hairy; gills spatulate, broadest just proximad of the middle, three or four times as long as broad; tips rounded or obtusely pointed and dark, and two dark cross-bands proximad of the tip; gills sometimes nearly black.

Measurements: length, 19-20 mm.; length of abdomen, 14 mm.; length of gills, 7-9 mm.; width of gills, 2-3 mm.; length of median lobe, 3.5-4 mm.; width of median lobe, .5-1.7 mm.

Adult, male.—Color dark brown and yellow.

Head: brown and buff. Antennae dark brown with a short basal segment and a much longer second segment; anteclypeus and labrum pale yellow or greenish, also mandibles and trochantins, genae and front to the fronto-clypeal suture; vertex and remainder of front dark brown; occipital and postgenal regions largely dark brown or black, pollinose with age.

Thorax: brown and yellow; median lobes of the pronotum each with an irregular H-shaped mark; stigmal plates brown and black; pleural sutures and dorsal carina pale, the mesopleural pale, stripe but little contracted caudad and becoming bluish with age; legs striped yellow and black, the tarsi and claws uniform brown or black; wings with 10-11 postnodal cross-veins, and M_2 arising between the third and fourth of these in the front wing.

Abdomen: dark brown, often with a trace of metallic green; dorsum of terga 1-10 brown, the brown widened subapically on 2-6, enclosing a lateral yellow spot on 3-6; segment 9 black except small lateral yellow spots; anal appendages consisting of broad superiors which are coarsely tuberculate laterally and have two strong mesal teeth; inferiors nearly as long as superiors, flattened and placed horizontally, and slightly swollen at apices.

Female.—Color similar to the male.

Abdomen: without the lateral enclosed yellow spots of 3-6; ovipositor extending caudad of segment 10.

Measurements: total length, male 44, female 39-41 mm.; length of abdomen, male 30, female 29-32 mm.; length of hind wings, male 23-24, female 24 mm.; width of hind wings, male 5, female 5 mm.

Connecticut.—New Haven, 26 June, 1902 (E. J. S. M.), 20 July, 1904 (W. E. B.); Hamden (Lake Whitney), 17 June, 1904 (H. L. V.).

New England.—June 17-September 5.

***Lestes inaequalis* Walsh**

Proceedings of the Academy of Natural Sciences of Philadelphia, 385: 1862.

Nymph.—Unknown.

Adult, male.—Color metallic green, bronze and black; yellow below.

Head: green and yellow; postclypeus metallic green or black, the anteclypeus and labrum, except short black stripes on the lateral margins, pale yellowish green; exposed portions of the mandibles, the genae as far dorsad as the fronto-clypeal suture yellow, the remainder of the front and vertex green; occiput and postgenae largely yellow; eyes brown.

Thorax: metallic green above, yellow or buff below; pronotum usually black and green, becoming pollinose; mesopleural suture and dorsal carina black in older specimens; mesepimera green except the cephalo-ventral shoulders, which are yellow; caudo-dorsal angle of the metepisterna green; the remainder of the metapleura, and the venter of thorax yellow; legs striped, the femora with pale dorsal carina, the tibiae pale above except at tip, and the tarsi and claws black; wings usually clear,¹¹ with 13-16 postnodal cross-veins in the front wing, 12-14 in the hind; M_2 arising between 3 and 5 in the front wing, and between 2 and 4 in the hind; stigma surmounting 2-3 cells.

Abdomen: metallic green or bronze, the apical segments dull black, segment 9 pollinose in older specimens; lateral margins of terga 1-10 yellow or pale, sterna black; superior anal appendages (Fig. 12, No. 9) long, black, a little paler at base, the ventro-mesal margins with a large basal tooth and a number of small spines distad of this; inferiors dark at tips, pale at base; longer than the superiors, swollen at base, the tips with numerous pale silken hairs.

Female.—Color similar to the male though usually lighter.

Ovipositor with the lateral plates widely separated from segment 10, the ventral half black; sternites of the eighth segment with angulate caudal margins.

Measurements: total length, male 46-48, female 47-49 mm.; length of abdomen, male 37-38, female 35-38 mm.; length of hind wings, male 25-29, female 25-28 mm.; width of hind wings, male 5-6.5, female 5-5.5 mm.

A near relative of *eurinus* and *uncatus*, but longer or more slender than either of these.

Connecticut.—Stratford, 9 July, 1920; Litchfield, 22 July, 1920 (P. G.); New London, 16-22 June, 1921 (R. H. H.); Litchfield, 3 July, 1915 (L. B. W.).

New England.—June 17-September 19.

¹¹ One specimen in Connecticut Agricultural Experiment Station collection has flavescens wings.

Lestes rectangularis Say

Journal of the Academy of Natural Sciences of Philadelphia, 8: 34: 1839.

Nymph.—Color buff or green.

Head: wider than long, caudo-lateral margins of the head without or with few setae; labium extending between the metacoxae; mental setae usually 6; lateral 3.

Thorax: legs with rows of spines, the apices of the femora fuscous and with a subapical dark ring; apices of the tibiae and distal half of the third tarsal segment fuscous.

Abdomen: lateral keels with apical spines on 5-9; sterna with a double row of median apical spots, two to each segment; segment 10 hairy beneath; gills similar to those of *forcipatus*, usually brown, sometimes nearly black, and with at least 3 cross-bands on each.

Measurements: length, 22 mm.; length of abdomen, 17 mm.; length of gills, 9.5 mm.; width of gills, 2.3 mm.; length of median lobe, 4 mm.; width of median lobe, .5-2.0 mm.

Adult, male.—Color dark brown (metallic bronze) to black, and sulphur yellow.

Head: brown and yellow, labium pale; antennae brown; postclypeus dark brown, sometimes metallic; anteclypeus, labrum, exposed portion of the mandibles, their trochantins and the genae yellow; front and vertex dull brown or bronze, nearly black; occiput and postgenae black, pollinose with age.

Thorax: brown and yellowish; pronotum yellowish buff, the cephalic lobe with a median brown spot, the median lobes each with an irregular H-shaped mark, which may cover most of the lobe; anepisterna of the mesothorax each largely covered by a brown longitudinal stripe; pale stripe of the mesopleural suture widest near the pronotum, narrowed near the wing bases and often bluish in color; mesepimera with longitudinal brown stripes from caudal margin to cephalic shoulder, widened and in contact with the mesopleural suture adjacent to the wing bases, narrowed cephalad and coming to a rather abrupt end on the cephalic shoulder; margins of the stripe irregular; metepisterna pale yellow with a triangular brown spot on caudo-dorsal angle; remainder of the pleura and the intersternum yellow or buff; legs striped; tarsi and claws brown, the dorsum of the tarsal segments usually yellow; front wings with 11 to 15 postnodal cross-veins M_2 arising between the third and fifth in the front wing, and between the second and fourth in the hind; stigma surmounting slightly more than two cells in both wings.

Abdomen: brown and yellowish, sometimes faintly metallic, long and slender; terga 1 and 2 brown on dorsum, pale on the sides, the stripe on 2 contracted near the middle or completely interrupted; terga 3-7 with yellow lateral margins; narrow basal

rings and longitudinal stripes on 8 and 10, and a triangular lateral apical spot on each side of 9; anal appendages brown or blackish, the superiors mostly smooth and not tuberculate or spinose on the lateral surfaces (only two small spines in some), the basal mesal tooth smaller than the tooth at the distal third; inferiors more than half the length of the superiors, black, the tips laterally compressed.

Female.—Color similar to the male.

Abdomen: shorter than the male; ventral half of the lateral valves of ovipositor usually black.

Measurements: total length, male 46-52, female 43-46 mm.; length of abdomen, male 33-42, female 31-34 mm.; length of hind wings, male 18.5-24, female 20-23 mm.; width of hind wing, male 4.5-5, female 4.5-5 mm.

Connecticut.—New Haven, 27 July, 1904 (P. L. B.); Branford, 6 July, 1905 (H. W. W.), 11 August, 1921; Stratford, 9 July, 1920; Easton, 6 July, 1922 (P. G.).

New England.—June 20-September 19.

***Lestes uncatus* Kirby**

Catalogue of Odonata, 160: 1890.

Nymph.—Color buff or green.

Head: mental setae 6 or 7 on each side; lateral setae 3 (rarely 4); marginal setae of the mentum extending to the base of the expanded portion; labium, when folded, extending caudad of the metacoxae.

Thorax: legs with apices of the femora and the apices of the tibiae and the distal half of the third tarsal segment brown; wing cases extending to the middle of the fourth abdominal segment.

Abdomen: with well-developed lateral keels, which are provided with apical spines on segments 5 or 6-9; dorsum of segments 9 and 10 and venter of 10 with long silken hairs; female ovipositor extending beyond the apex of the proximal gill segment; gills contracted beyond the middle as in *rectangularis* and *forcipatus*, rather sharply pointed at apices, the point similar to those of *unguiculatus*.

Measurements: length, 18-24 mm.; length of abdomen, 11 mm.; length of gills, 8-10 mm.; width of gills, 2 mm.; length of median lobe, 5.5 mm.; width of median lobe, .3-1.6 mm.

Adult, male.—Color bright metallic green and pale yellow.

Head: dark green above, pale below; occiput and postgenae black and green; antennae black; postclypeus green or black, the anteclypeus, labrum, exposed portions of the mandibles, their trochantins and the genae pale yellow; front, vertex, clypeus and labrum pilose, the hairs pale; a pale spot present beside each of the lateral ocelli and one in front of the median.

Thorax: metallic green, black or yellow; pronotum green, propimera and episterna black, or pollinose in older specimens; dorsal carina of mesothorax black, anepisterna green, the katepisternum and mesopleural suture largely black; mesepimerum green except the cephalo-ventral shoulders; metapleural suture usually black, the stripe indefinite, increasing with age and covering a large portion of the metepimera (probably absent in tenerals); postcoxal areas buff; legs black and buff, striped, tarsi and claws black; wings clear; postnodal cross-veins 10-12, the stigma of the front wings surmounting 2 cells or less; M_2 arising between the second and fourth postnodal cross-vein in the front wing.

Abdomen: metallic green; dorsum of the first tergum green, sometimes pollinose; tergum 2 green, the latero-ventral margins pale or pollinose; 3-7 with dorsa green, and lateral margins and interrupted basal rings, yellow; terga 8, 9, and 10 black or bronze above, black and pollinose on the sides; superior anal appendages black at tips or entirely black, the lateral surfaces tuberculate, the mesal margins with a large basal tooth, and smaller ones beyond to the distal third; inferiors broad, black, expanded at apices, flattened and nearly in a horizontal plane.

Female.—Color metallic green and yellow.

Thorax: usually lacking the metapleural black stripe.

Abdomen: proximal half of the first tergum with dorsum pale; terga 8-10 with lateral margins pale; ovipositor with lateral plates black on the ventral half, the apex extending well behind the tenth segment.

Measurements: total length, male 34-36, female 39 mm.; length of abdomen, male 26-28, female 29 mm.; length of hind wings, male 21, female 23 mm.; width of hind wings, male 4.5, female 4.5 mm.

Connecticut.—Stratford, 9 July, 1920; Hamden, 4 July, 1921 (P. G.); Windsor, 20 June, 1926 (J. L. R.).

New England.—May 30-September.

Lestes unguiculatus Hagen

Synopsis of the Neuroptera of North America, 70: 1861.

Nymph.—Color light brown or green.

Head: second antennal segment longer than the first; labium extending between meso- and metacoxae; mental setae usually seven, laterals three; lateral marginal setae of the median lobe extending from the articulation of the palpus to the base of the expanded portion.

Thorax: legs slender, the femora with rows of short setae and faint preapical rings of brown; tibiae brown at the apices; apical half of the third tarsal segment and the claws, brown; meta-thoracic wing-cases extending to the apex of 3 or middle of fourth abdominal segment.

Abdomen: with apical spines on the lateral keels of segments 5-9, venter of the abdomen often with dark stripes beneath the lateral keels, and the caudo-lateral angles of terga 1-8 with dark spots above the lateral keels; gills (Pl. 1, Fig. 1) widest near the base, and gradually tapering to a point at apex, not contracted beyond the middle and widened again beyond as in *rectangularis* and *forcipatus*; ovipositor extending to the apex of the tenth segment.

Measurements: length, 19 mm.; length of abdomen, 14 mm.; length of gills, 9 mm.; width of gills, 1.5-2 mm.; length of median lobe, 4 mm.; width of median lobe, .5-1.5 mm.

Adult, male.—Color dull brown or metallic green, and yellow.

Head: metallic green and brown, often more or less bronzed; proximal segment of the antennae pale at apex; occiput and post-genal regions wholly or in part yellow; pollinose or nearly black in older individuals.

Thorax: dull brown and yellow, sometimes partly metallic, but never uniform bright green; pronotum with irregular H-shaped marks on the median lobes or entirely dark and pollinose; mesothorax brown or greenish, with yellow dorsal carina, mesopleural suture, and cephalic shoulder of the epimerum; the katapisterna are yellow and brown or black; metathorax usually yellow except a triangle of brown on caudo-dorsal angles of the episterna; sometimes obscurely blackened and pollinose; wings clear, the post-nodal cross-veins 9-11 and M_2 arising between the second and third of these in the front wing, usually near the second in the hind.

Abdomen: mostly yellow in tenerals, dark metallic green or brown in older specimens; dorsum of terga 1 brown on caudal half, or pollinose; terga 2-10 all dark on dorsum, 2-7 sometimes green, lateral margins of 2-7 pale; sides of 2 and 8, and nearly all of 9 and 10 frequently pollinose; anal appendages dark, the superiors pale at base, the ventro-mesal margins with a spine near base and a row of spinules beyond to the distal third of the appendage; inferiors S-shaped, the apical portions curved in an opposite direction from the superiors.

Female.—Color similar to the male.

Abdomen: with wider lateral stripes on the terga, and pollinosity usually undeveloped; ovipositor reaching the apex of the tenth segment, the lateral valves black on about the ventral third, and ventral margins of terga also black.

Measurements: length, male 36-39, female 35 mm.; length of abdomen, male 27, female 26-27 mm.; length of hind wings, male 18-21, female 21-22 mm.; width of hind wings, male 4.5-5, female 4.5-5 mm.

Connecticut.—Stratford, 9 July, 1920; Guilford, 27 July, 1920 (P. G.).
New England.—June 15-September 8.

Lestes vigilax Hagen

Bulletin de l'Academie royale . . . de Belgique, 16: 214: 1862.

Nymph.—Color light green or brown.

Head: labium (Fig. 7, No. 4) when folded extending nearly to or between the metacoxae; mental setae five or six, laterals usually three; marginal spinules of the mentum apparently wanting or few in number; teeth of the distal margin of the median lobe and the mesal margins of the palpi are square-tipped, and the furrow representing the median cleft of the median lobe is conspicuous and extends proximad about one-third the length of the expanded portion.

Thorax: femora and tibiae with rows of short setae, the femora with subapical brown rings, the tips of the tibiae and apical half of the third tarsal segment dark; wing cases extending about to the middle of the third abdominal segment.

Abdomen: lateral keels with apical spines on segments 1-9, the spine on segment 9 especially long; gills (Pl. 1, Fig. 2) long and slender, about equal in width throughout, the apices bluntly pointed; median gill frequently shorter than the laterals; ovipositor nearly reaching the apex of segment 10.

Measurements: length, 21-30 mm.; length of abdomen, 17-22 mm.; length of gills, 9-11 mm.; width of gills, 1.25-1.75 mm.; length of median lobe, 3.3-4 mm.; width of median lobe, 1.5-2 mm.

Adult, male.—Color dull metallic green, and buff or yellow.

Head: dull greenish or black; labrum brown or blue; front and vertex metallic green; occiput and postgenae mostly metallic green, sometimes black and pollinose.

Thorax: metallic green, yellow below; prothorax largely black, or metallic green and brown (teneral); mesothorax with green anepisterna and epimera, the mesopleural suture with a brown stripe which becomes black; dorsal carina brown (teneral), black in older specimens; metathorax yellow except the caudo-dorsal angles of the episterna, but older specimens frequently obscurely marked with black, and pollinose; legs striped, the coxae and trochanters usually pale; tarsi and claws black, and frequently the tibia also; wings with 15-17 postnodal cross-veins in the front wing; stigma surmounting two and one-half to three cells.

Abdomen: green above on terga 1-7 or 8, lateral margins of 1-6 pale; segments 9 and 10 usually dark brown or black, 9 and 10 becoming pollinose; superior anal appendages (Fig. 12, Nos. 12 and 13) dark brown or black, the ventro-mesal margins each with a large subbasal tooth and a rounded indentation about the middle; between the basal tooth and the indentation are a number of small spinules; there is a second indentation beyond the median one; inferiors slender, about three-fourths as long as the superiors, the basal third greatly enlarged.

Female.—Color similar to the male.

Thorax: mesopleural pale stripe not becoming black, usually remaining brown and contracted near the wing bases; dorsal carina brown; metathorax remaining yellow for the most part and usually not pollinose.

Abdomen: dorsum of terga 1-9 green, the lateral margins yellow, fading into brown, segment 10 brown; ovipositor extending caudad of segment 10, the ventral margins of the lateral valves usually brown.

Measurements: total length, male 43-47, female 43-45 mm.; length of abdomen, male 34-38, female 34-36 mm.; length of hind wings, male 21-25, female 24-27 mm.; width of hind wings, male 4.5-5, female 5-6 mm.

Connecticut.—New Haven, 4 July, 1905 (H. L. V.); Hamden, 28 June, 13, 27 July, 3 August, 1920 (P. G.); Guilford, 22 July, 1920 (P. G.); New London, 7-22 June, 1921 (R. H. H.); Litchfield, 25 July, 1915 (L. B. W).

New England.—May 28-September 7.

Family AGRIONIDAE Leach

The nymphs are sprawling in appearance and easily recognized among Zygoptera by means of labial and gill characters. The two lateral gills are three-sided, and the labium possesses a deep median cleft.

The adults include the black-winged *Calopteryx* or *Agrion*, a widely distributed species commonly found along small brooks. Their wings possess a great many more cross-veins in all parts than are found in other Zygoptera.

Key to Genera

Nymphs

1. Median cleft of median lobe of labium extending proximad of the articulations of the labial palpi (Fig. 7, No. 10) **Agrion**, p. 108
- Median cleft of the median lobe extending only to the base of the articulation of the labial palpi **Hetaerina**, p. 113

Adults

1. Wings with basilar space without cross-veins; metapleural suture only with a pale stripe; often the entire pleura without pale marks **Agrion**, p. 108
- Wings with cross-veins in the basilar space; mesopleural, interpleural and metapleural sutures with pale stripes. . **Hetaerina**, p. 113

Genus *Agrion* Fabricius

The nymphs are dark in color, including the gills which, however, have light bands across the middle. The femora of all the legs also have light bands at about the distal third.

The adults are dark species, the cuticle being blue or green and shiny or metallic in appearance; wings with a great many cross-veins and few hexagonal or pentagonal cells.

Nymphs of the genus are found in small meadow or woodland brooks commonly among the roots of willow trees. The adults are remarkable for their bright metallic coloration and their dark wings, which make them conspicuous when in flight; and they are sometimes known as "blackwings." *Calopteryx* is a synonym of *Agrion*.

The members of this genus are all stream-inhabiting species.

Key to Species

Nymphs

The nymphs known at the present time do not possess characters enabling one to prepare a key to species. The basal segment of the antennae in *aequabile* is longer than the head, while in most specimens of *maculatum* it is slightly shorter.

Adults, Males

1. Wings entirely smoky or opaque*maculatum*
Wings with apical fourth or sixth only, smoky, the remainder hyaline, transparent 2
2. Occiput without a prominent tubercle on each side*aequabile*
Occiput with a prominent tubercle on each side behind the eyes ... 3
3. Wings with apical fifth or sixth black; antenodal cross-veins 18-24*dimidiatum apicale*
Wings with apical fourth brown; antenodals about 30*amatum*

Females

1. Pterostigma without cross-veins; occiput without prominent tubercles; dorsum of segment 10 of abdomen with a sharp spine 2
Pterostigma with cross-veins; occiput with prominent tubercles .. 3
2. Hind wings not over 36 mm. in length by 9 to 9.5 mm. in width*aequabile*
Hind wings more than 36 mm. in length by 8 to 9 mm. in width*amatum*
3. Pterostigma with 6-12 cells; wings uniformly smoky, sometimes slightly darker at tip*maculatum*
Pterostigma with less than 6 cells; wings not uniformly smoky, the apical fourth or sixth darker than the rest 4
4. Stigma white; length of hind wings about 30 mm. *dimidiatum apicale*
Stigma yellow; length of hind wings 38 to 40 mm.*amatum*

Agrion aequabile (Say)

Journal of the Academy of Natural Sciences, Philadelphia, 8: 33: 1839.

Nymph.—Color dark or light brown.

Head: basal segment of the antennae longer than the head, the distal segments together about two-thirds the length of the prox-

imal; hind margins of the head bluntly angulate; labium similar to that of *maculatum* (Fig. 7, No. 10), the median cleft extending half its length proximad of the labial palpi.

Thorax: in some specimens marked with black on the sides; metathoracic wing-cases extending to the middle or hind margin of segment 4, hind femora to the middle of segment 5 or 6.

Abdomen: uniform brown or the caudal margins of the segments dark; gills dark, usually with paler band at the middle, the median gill with two pale cross-stripes.

Measurements; full grown nymph: total length including gills, 40 mm.; length of hind femora, 8.5 mm.; metathoracic wing-cases, 6 mm.; length of abdomen, 19 mm.; tracheal gills, 13 mm.; length of basal segment of antennae, 4.5 mm. Young nymph: total length, 26 mm.; length of hind femora, 8 mm.; metathoracic wing-cases, 4.5 mm.; length of abdomen, 12 mm.; gills, 8.5 mm.

Described from a nymph obtained from Dr. R. H. Howe, and another identified by comparison, in the collection of the Connecticut Agricultural Experiment Station.

Adult, male.—Color metallic green, sometimes blue.

Head: mouth-parts black; antennae entirely black; labrum and sometimes the clypeus black; clypeus, front, and genae metallic green, and clothed with dark hairs.

Thorax: metallic green, black and green below; caudal lobe of the pronotum convex, the margin entire; intersternum green; legs entirely black, the ventral setae much longer than the intervals between them; wings transparent, except the apical third of each which is smoky; stigma wanting; antenodal cross-veins variable, 26 in Connecticut specimens.

Abdomen: green and blue; anal appendages (Fig. 12, No. 5) mostly black, the superiors wholly black, long and curved, spinose on the lateral surfaces, and emarginate on the mesal margins at middle; inferiors black at apex, paler at base, nearly as long as the superiors and each provided with a small apical tooth directed mesad.

Female.—Color metallic green and buff.

Head: proximal half of the second antennal segment with a pale lateral spot; labrum buff-colored on each side; exposed portions of the mouth-parts including mandibles and their trochantins, buff.

Thorax: latero-ventral margins pale, including the cephalo-ventral margins of the mesanepisternum, caudal half of the metakatepisternum, a stripe along the metapleural suture extending more than half way from the cephalic margin to the wing bases, and the ventral and cephalic margins of the metepimera, and intersternum green; wings slightly smoky, but not darker on the apical third; stigma present, composed of one cell (Fig. 12, No. 7), white.

Abdomen: metallic green and black, the apical portion dull and paler below; tergum of segment 10 with a mesal ridge produced in a spine at the apex of the segment; ovipositor reaching the middle of segment 10.

Measurements: total length, male 51, female 46-49 mm.; length of abdomen, male 38-39, female 36-38 mm.; length of hind wings, male 32 mm.; female 32-35 mm.; width of hind wings, male 9, female 9.5 mm.

Variations According to Different Authors

	Length	Abdomen	Hind Wings
Male	49-51 mm.	34-40 mm.	27-32 mm.
Female	44-49 mm.	30-41.5 mm.	29-35 mm.

Connecticut.—Mount Carmel, 2 June, 1906, 6 June, 1908 (B. H. W.); New London, 8 June, 1921 (R. H. H.); Litchfield, 5 July, 1909, 2, 4 July, 1916 (L. B. W.).

New England.—May 10-July 21.

***Agrion amatum* Hagen**

Psyche, 5: 244-245: 1889.

Nymph.—Unknown.

Adult, male.—Color metallic green and bronze.

Head: dark green or metallic bronze; labium pale at sides, labrum pale with dark spots above and below on margins at meson; first antennal segment pale; rear of head angulate but not as decidedly tuberculate as in *apicale*.

Thorax: green, pale below, bluish pollinose in some specimens; legs black; wings with about the apical fourth brown in hind wings only.

Abdomen: metallic green, darker below; anal appendages black, the inferiors about three-fourths the length of the superiors, the superiors in dorsal view with a blunt tooth just beyond the middle on the mesal margin and with large spines on the exterior surfaces.

Female.—With a prominent spine and ridge on the dorsum of segment 10.

Measurements: total length, male 56, female 52 mm.; abdomen, male 42, female 40 mm.; length of hind wings, male 37, female 38-39 mm.; width of hind wings, male 8, female 8-9 mm.

Description based on specimens in the Cambridge Museum of Comparative Zoology.

Connecticut.—Litchfield, June 30, July 4, 1913; 3 June, 1925 (L. B. W.).

***Agrion dimidiatum apicale* (Burmeister)**

Handbuch der Entomologie, 2: 827: 1839.

Adult, male.—Color bright metallic green, wings tipped with brown.

Head: labium and antennae black; labrum, clypeus, front vertex, occiput and postgenae green; rear of head with prominent tubercle on each side.

Thorax: green, black below; legs black; wings narrow, their apices infuscated for 5 mm. to 6 mm. from the tip or less.

Abdomen: uniform metallic green; anal appendages black, similar to those of *maculatum*.

Female.—Stigma white, provided with 2-5 cells; the wings usually without dark tips; a prominent ridge and blunt spine on dorsum of segment 10.

Measurements: total length, male 43-45, female 37-41 mm.; length of abdomen, male 34, female 30-33 mm.; length of hind wings, male 26-27, female 27 mm.; width of hind wings, male 7, female 7-7.5 mm.

A male specimen in the Yale University collection taken at "So. Reading" belongs here.

New England.—June 21-July 21.

Agrion maculatum Beauvois

Insectes recueillis en Afrique et en Amérique, etc., 85: plate 7, f. 3: 1805.

Nymph.—Color dark brown.

Head: pentagonal, a little contracted behind the eyes; eyes black, a black stripe nearly the width of the eye extending to the caudal margin of the head, and another stripe extending from the antennal fossae to the eyes; proximal segment of the antennae thick, about as long as the head, and usually longer than all the remaining segments together; labium (Fig. 7, No. 10) with deeply cleft median lobe, the cleft extending proximad of the articulations of the palpi; proximal segment of the palpus with 3 immovable end-hooks and 2 small setae near the base of the distal segment.

Thorax: prothorax with a broad dark line on each lateral margin which is continuous with the dark line on the side of the head; legs with whitish femoral bands on the apical third of each, beyond which the femur is brown; also a brown band proximad of the white one.

Abdomen: subcylindrical, dark, and without prominent lateral keels; apical margins of the terga with about four dark spots on the dorsum; lateral tracheal gills three-sided, somewhat blunt, with a white transverse band near the middle; median gill flat, shorter, with a similar white band at the middle and another faint one beyond; marginal setae of the gill long and slender and extending entirely around it.

Measurements: length, 20 mm.; length of abdomen, 15 mm.; length of lateral gills, 10-12 mm.; length of metathoracic wing-cases, 6 mm.; length of median lobe, 4.5 mm.; width of median lobe, 1.3-3 mm.

Adult, male (Pl. xvii, a).—Color metallic blue or green.

Head: green or blue; labium black, antennae black; clypeus and labrum metallic green or blue; front together with the clypeus and labrum thinly pilose; eyes black or slate-colored.

Thorax: green or blue above, black below; pronotum with the caudal lobe convex; dorsal carina of mesothorax black; paraptera subquadrangular, the caudal margins emarginate or sinuate; ventral portion of the metepimera and the intersternum wholly black and subshining; legs black, the setae also black and longer than the intervals between their bases; anterior femoral setae 14 or 15 on each side, tarsi black; wings very dark, almost opaque and about one-third as wide as long (sometimes variable, parts of the wing being smoky and not opaque); stigma wanting; antenodal cross-veins 24-28.

Abdomen: nearly cylindrical, glabrous, and striated transversely; superior anal appendages long and black, the lateral surfaces subcircular in outline, the mesal surfaces emarginate about the middle; inferiors as long as the superiors, straight, and with a small apical hook directed mesad (Fig. 12, Nos. 3, 4).

Female.—Color metallic green.

Head: as in male.

Thorax: wings pale brown, darker at tips and transparent; stigma present, white (Fig. 12, No. 6); antenodal cross-veins 23-26.

Measurements: length, male 43-46, female 41-42 mm.; length of abdomen, male 32-38, female 32-33 mm.; length of hind wings, male 28-29, female 29-30 mm.; width of hind wings, male, 9.5-10, female 10 mm.

Connecticut.—Scotland, 25 July, 1904 (B. H. W.); Mount Carmel, 27 August, 1904 (P. L. B.); Orange, 21 July, 1905 (W. E. B.); Branford, 28 July, 1905 (H. L. V.), 5 July, 14 August, 1905 (H. W. W.); Goshen, 6 July, 1919 (M. P. Z.); New London, 6-16 June, 1921 (R. H. H.); Litchfield, 26 July, 1916 (L. B. W.).

New England.—April 16-August 27.

Genus *Hetaerina* Hagen

The nymphs are similar in structure but much lighter in color than those of *Agrion*. The median cleft of the mentum does not extend proximad of the articulation of the labial palpi; and the gills are also much lighter in color than those of *Agrion*.

Adults of this genus are distinguishable by means of the bright carmine patch at the base of the wings in the male. The cuticle is dark green or bronze, but rarely as dark as the cuticle in the genus *Agrion*.

Only one species (*americana*) is known from the New England States, but a second (*titia*) occurs in the Middle West. The latter species, however, is easily distinguished from *americana* by the brown color at the base of the hind wings of the male and the

color of the legs, which are entirely dark in *titia*. The nymph of *titia* is unknown.

The genus contains another stream-inhabiting species in Connecticut, and this has only been collected in two localities. Strange to say, both of these collections were made within a few days of one another near the last of August, but it is known to fly late in the summer, being reported from Illinois as late as October 22.

Hetaerina americana Fabricius

Entomologia Systematica, Supplement, 287: 1798.

Nymph.—Color brown or greenish.

Head: pentagonal; proximal segment of the antennae nearly as long as the remaining segments of each; labium, with median cleft hardly extending proximad of the articulations of the labial palpi; palpi with three end-hooks and five or six (3 prominent setae) small setae at the base of the distal segment or hook, caudolateral margins of the head forming a blunt tubercle.

Thorax: lateral margins of pronotum elevated, scalloped and the margins produced at two points on each side. In younger specimens the proximal half of each femur is dark brown, which is followed by a light band beyond which the tip is again dark; tibiae with three faint dark rings, and with dark bases and apices; apical half of third tarsal segment dark, claws dark.

Abdomen: lateral keels not armed with spines though ending in blunt tubercles on segments 8 and 9; lateral gills three-sided, the median one flat and shorter than the lateral; median gill with dark axis and three dark cross-bands; lateral gills buff-colored, the three margins each with three dark spots and three to four lighter colored areas.

Measurements: length (excluding gills), 23 mm.; length of abdomen, 12 mm.; length of lateral gills, 8.5-10 mm.; length of metathoracic wing-cases, 6 mm.; length of median lobe of labium, 4 mm.; width 1.3-3 mm.

Adult, male (Pl. xvii, Fig. a).—Color bronze and metallic green, bases of the wings carmine.

Head: labium and labrum brown, the labrum with a black spot at middle of the dorsal border; ventral margin of clypeus and basal segment of the antennae also brown, the latter with a dark spot at middle; remainder of the head bronze or metallic green.

Thorax: bronzy green, the lateral sutures lined with pale color; mesopleural suture frequently black; venter pale; legs dark brown to black; the coxae mostly pale, femora below and tibiae above pale; tarsi and claws black; wings clear, the bases of each carmine from base half way to nodus; hind wings brown along costal border in front of the carmine color.

Abdomen: metallic green, bronze or very dark brown towards the tip; the lateral margins of terga 1-6 inclusive and basal rings

of 3-6 pale. Anal appendage with superiors about three times as long as the blunt inferiors, and pale at bases, darker towards their apices; the ventro-mesal margins of each with two rounded lobes just beyond the middle.

Female.—Color bright metallic green, the bases of the wings not carmine as in the male. There is considerably more pale color on the thorax, and abdominal terga 1-10 are broadly margined with yellow; ovipositor yellow.

Measurements: total length, male 44-46, female 40-45 mm.; length of abdomen, male 33-35, female 30-35 mm.; length of hind wings, male 28, female 28-30 mm.; width of hind wings, male 5.5, female 6-6.5 mm.; length of pterostigma, male and female .5-1 mm.

Connecticut.—Kent, 31 August, 1904 (W. E. B.); Windsor, 29 August, 1925 (L. B. W.).

Suborder **Anisoptera** Selys

The nymphs of the Anisoptera lack caudal tracheal gills but are provided with rectal gills which supply the necessary oxygen to the blood. They are much more robust than the nymphs of Zygoptera.

Adults of this suborder are larger in every way than the adults of Zygoptera, their flight is much more rapid and certain, and they rest without exception with wings spread horizontally.

Key to Families

Nymphs

- 1. Labium forming a more or less spoon-like mask for the ventral surface of the head; the mentum never with two large teeth at the middle of the distal marginLIBELLULIDAE, p. 108
- Labium flat, not forming a spoon-like mask for the ventral part of the head; or if spoon-like, then the mentum produced triangularly in front with two teeth at the middle of the distal margin 2
- 2. Distal margin of the mentum cleft; front and middle tarsi with three segments 3
- Distal margin of the mentum continuous; front and middle tarsi with two segmentsGOMPHIDAE, p. 124
- 3. Labium spoon-like and covering the ventral and cephalic surfaces of the head up to the antennae; median lobe angularly produced with two teeth at the apex (Fig. 7, No. 1); wing-cases of nymphs (not exuviae) strongly divergentCORDULEGASTERIDAE, p. 118
- Labium not spoon-like or covering the ventral and cephalic surfaces of the head to the antennae; median lobe not angularly produced or with teeth at the apex; wing-cases of nymphs not strongly divergent. 4
- 4. Antennal segments shorter than wide; mentum with a broad shallow cleftPETALURIDAE, p. 116
- Antennal segments longer than wide; mentum with a narrow cleft usually reduced to a lineAESHNIDAE, p. 169

Adults

1. Labial palpi meeting in a line on the meson; antenodal cross-veins of the first and second series usually¹² corresponding or in line with one anotherLIBELLULIDAE, p. 198
 Labial palpi not meeting in a line on the meson; antenodal cross-veins of the first and second series not corresponding or in line with one another except the first and usually one other, which varies in position 2
2. Compound eyes contiguous for a considerable distance above ... AESHNIDAE, p. 169
 Compound eyes touching at a single point only, or widely separated 3
3. Compound eyes subcontiguous or contiguous at a single point; some of the spines of the middle and hind tibiae of the male replaced by small tubercles, each with a small seta alongside; stigma without an oblique or with a very slightly oblique cross-vein caudad of its proximal end and not more oblique than other cross-veins in that vicinityCORDULEGASTERIDAE, p. 118
 Compound eyes widely separated, the distance between them being as much or more than half the distance between the antennae; spines of the second and third tibiae of the male not replaced by small tubercles 4
4. Labium (mentum) bifid; female with a long ovipositor (Fig. 24, No. 1)PETALURIDAE, p. 116
 Labium entire; female without a long ovipositor, the latter greatly reduced and not extending to the caudal margin of segment 9 GOMPHIDAE, p. 124

Family PETALURIDAE

Adults and Nymphs

This family is represented in North America by a single genus *Tachopteryx*, including only two species in the United States. The adults have a bifid labium and the nymphs are characterized by the possession of antennae with subequal segments, these segments being wider than long.

Genus *Tachopteryx* Selys

The nymphs are provided with thick stout legs. The labium is broad and has a shallow cleft at tip of median lobe, the distal margin of which is provided with very small teeth.

Adults of this genus have a very oblique cross-vein supporting the proximal end of the long narrow stigma.

Very little is known of the habits of the only species of this genus in the eastern United States. It has usually been observed resting on trees or fences near streams or marshy areas.

Tachopteryx thoreyi Hagen

Monographie des Gomphines, 373: 1858.

Nymph.—The following description is taken from Williamson, Ent. News, 12: 1-3: 1901:

¹² In *Tramca* (Libellulidae) these veins frequently do not correspond (Pl. xv, Fig. 2).

"Head: wide, angular, square, convex in front, concave behind, the eyes placed in the outer anterior corners; roughened, generally sparsely hairy, edges and tubercles with dense bristle-like hairs; on each side, back of the eyes, two prominent edges and a less developed one above; face in front of base of antennae vertical; antennae 3.5 mm. long, hairy, flattened, the basal joint largest, terete, with the external edge angular; last joint small, apex irregular; other joints about equal in size, slightly larger basally, about half as long as wide. Labium short and broad; middle lobe square, 4.5 mm. long and 5.5 mm. wide, abruptly narrower near the posterior end; anterior edge with a larger tooth on either side of the median line and about ten smaller ones on either side; extending posteriorly to half way between the bases of the first and second pairs of legs; lateral lobes wide, opposed edges straight, notched with small serrations.

"Prothorax angular, high, dorsum and sides meeting at nearly a right angle, the edge produced laterally and clothed with bristly hairs; all of thorax scantily clothed with short hairs. The thorax widens and deepens from the prothorax to the metathorax at the base of the third pair of legs where it is as wide as the abdomen in its widest part. The front wing-cases extend to the posterior edge of the fourth abdominal segment; apparently the costae lie almost parallel; the cases of the hind wings reach to the middle of the fifth segment. Legs very robust, strongly formed, angular, especially the femora, the edges clothed with bristles; a deep depression in the mesosternum, between the second pair of legs to accommodate the hinge of the labium.

"Abdomen spindle-shaped, 23 mm. long, widest at the fifth segment where its width equals one-half its length, low, flattened, the sterna scarcely convex, terga convex, width of fifth segment 11 mm., depth 5 mm. Segment nine with a lateral posterior spine; on segments anterior this spine grows successively smaller, not present on first three segments. The mark, on the sternum of the ninth segment, of the ovipositor of the imago is conspicuous. On dorsum of segment five are two tufts of bristles, one on either side, separated from each other by about one-third the width of the segment, and placed a little nearer the posterior than the anterior margin of the segment; these tufts persist from the fifth to the ninth segments, the tufts on each segment successively approaching each other more closely till on the ninth they stand just on either side of the median line; each tuft is placed on an irregular elevation and in some cases seems to be double. Appendages short, middle one tapering; apex truncate, on either side produced to form a short tooth; laterals shorter, conical; inferiors compressed, wide, rounded triangular, longer than the middle appendage, the lower edges and the posterior ventral edge of the tenth segment between them bearing many long stiff, yellowish hairs.

"Length: 38 mm., including abdominal appendages; tarsi 3-3-3; antennae 7-jointed."

Adult, male.—Color gray with a bluish tint (lilac), sometimes with yellow.

Head: face pale, anteclypeus black, ventral margin and median spot on labrum, black; labium with bifid mentum; no postocellar ridge or occipital ridge as in Gomphidae; occiput pale with a black transverse stripe.

Thorax: mostly bluish gray, obscurely marked with brown; darker stripes on meso- and metapleural sutures and lateral carinae between venter and metepimera; wings with a long stigma 8-9.5 mm. long by less than 1 mm. wide; triangle with 1 to 2 cross-veins in front and hind wings, sectors of arculus (M_3 and M_4) well separated, the caudal section of the arculus longer.

Abdomen: terga 1-2 pale, pilose; 2 with 4 dark dorsal spots and a lateral spot on each side, caudal margin black; 3 with 2 dorsal spots and lateral margin pale; 4 with 2 dorsal black spots and black lateral margins, the caudal spot much wider; 3-7 similar to 4, the dark marks connecting with the blacker caudal margin; terga 8, 9 and 10 almost entirely black, obscurely pale; a transverse carina on terga 2-7 inclusive; anal appendages black or dark brown (Fig. 24, Nos. 2, 3).

Female.—With a broad well-developed ovipositor (Fig. 24, No. 1).

Measurements: total length, male 72-75, female 75 mm.; length of abdomen, male 50-58, female 54-55 mm.; length of hind wings, male 50-51, female 51-53 mm.; width of hind wings, male 15-16 mm.

Family CORDULEGASTERIDAE

This family is represented in the northeastern United States by a single genus, *Cordulegaster*. The adults are relatively slow fliers, and the nymphs inhabit small streams.

Genus *Cordulegaster* Leach

The nymphs differ from all others in the characters of the labium, the labial palpi being provided with large teeth on the mesal margin; and the median lobe with two large teeth on the distal margin (Fig. 7, No. 1).

In the adult the triangle is similar in both wings, and the super-triangle is frequently without cross-veins; the stigma is supported by a cross-vein at its proximal end, the cross-vein being only slightly oblique; M_3 and M_4 are well separated at the arculus; anal margin of the hind wings of the male angular; female provided with a very long ovipositor, and the thorax with three conspicuous yellow stripes on each side.

The nymphs of this genus are almost without exception found in small streams, the adults usually near the habitat of the nymph. The reared nymphs of *maculatus*, the only species which we have been successful in bringing through, were both found in small, rapidly flowing streams in shady locations. The adults are comparatively slow on the wing and more easily captured than the various Aeshnas or Libellulas. In captivity the nymphs will burrow into sand, leaving only the tip of the abdomen and the head protruding, and are very quick at capturing a struggling insect if brought within range of the labium.

For literature dealing with adults of the genus, see Needham, J. G., New York State Museum Bulletin 47: 474-478: 1901.

Key to Species

Adults¹³

Males and Females

1. Abdomen with a mid-dorsal line of yellow spots, those on segments 3-8 arrow-shaped **obliquus**
Abdomen without a mid-dorsal line of yellow spots; either with a double row of yellow spots or with transverse yellow bands .. 2
2. Abdomen with transverse yellow bands, at or about the middle of terga 3-8 3
Abdomen without transverse yellow bands, but with yellow spots on either side of the meson 4
3. Face yellow; eyes not contiguous [**sayi**]
Face blackish; eyes contiguous at a single point on the meson **erroneus**
4. Terga 2, 3 and 4 each with 4 small, somewhat circular yellow spots; eyes contiguous on the meson **maculatus**
Terga 2, 3 and 4 each with 4 small elongate yellow spots, the spots on each side of the meson in line, and contiguous on the different segments; eyes well separated at the meson **diastatops**

Cordulegaster diastatops Selys

Bulletin de l'Academie royale . . . de Belgique (2), 21: 101: 1854.

Adult, male.—Color brown, marked with yellow.

Head: labium brown; labrum, postclypeus, front and vertex, except the brown caudal margin, yellow; anteclypeus, preocular stripe and frontal vesicle, dark brown or black; rear of head light brown and yellow, dorsal margin behind the compound eyes shiny black; eyes separated by about .5 mm. on the dorso-meson.

Thorax: prothorax light brown, the caudal margin darker, meso- and metathorax brown with 3 yellow stripes, the dorsal stripe cuneiform, 1 mm. wide, the upper end rounded, lower end tapering; first lateral or mesepimeral pale stripe 1.5 mm. wide by 5-6 long, metepimeral about the same dimensions, the sides nearly parallel and the ends rounded; legs dark brown or black, the trochanters with an irregular glabrous area beneath, femora with

¹³ Only the nymph of *maculatus* has been reared; key adapted from Needham.

two irregular rows of short spines, often several abreast in each row; front row of spines of the middle and hind tibiae replaced by small rounded tubercles, each with small seta of about the same length placed distad of it and united with the tubercle at base; tarsi with distal segment about as long as the two proximal ones together, the claws with ventral tooth about the middle; claws about as long as the middle tarsal segment; wings clear; stigma brown, supported by 3-4 cross-veins; cubito-anal cross-veins 3; triangle with one cross-vein; anal triangle with 4-5 cells.

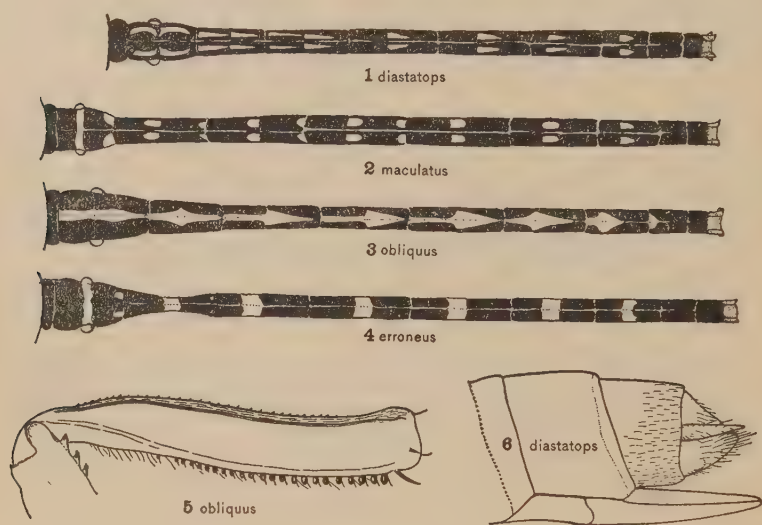


FIG. 13. *Cordulegaster* sp., structural details and color pattern of abdomen. Nos. 1 to 4, dorsal view of abdomens of *diastatops*, *maculatus*, *obliquus* and *erroneus*. 5. Tibia of male *obliquus* showing tubercles on ventral surface. 6. Ovipositor and terminal segments of *diastatops*.

Abdomen (Fig. 13, No. 1): brown with yellow spots as follows: 6 on second tergum, two being on the ventral margin (on each side) and two being on the lateral margin above the auricles; two cuneiform spots on each side of segment 3; median lateral triangular spots on the sides of 4-8; a minute dot at base of 9; lateral and dorsal carinae lacking on all terga, but the terga contiguous on the ventromeson on segments 3-8; anal appendages consisting of a broad inferior which is wider at apex than at base; superiors 1.2 mm. long, the tips obliquely truncate, and the ventral surface with a median tooth; accessory genital appendages consisting of prominent, bluntly pointed cephalic lamina with an elongate lateral

depression; hamules hook-like, slender, genital lobe projecting but slightly and with short spines and delicate marginal setae.

Female.—Similar to the male in general color; tibiae without the small tubercles of the male; compound eyes separated by .6 mm.; wings without anal triangle, somewhat flavescent, dorsal lateral spots on abdominal terga 2, 3 and 4 continuous and forming a yellow stripe on each side; anal appendages short, the superior slender, barely exceeding the inferior in length; ovipositor yellowish brown at base, darker, measuring about 5 mm. and extending beyond the anal appendages considerably.

Measurements: total length, male 56, female 65 mm.; length of abdomen, male 42, female 48 mm.; length of hind wings, male 37, female 42 mm.; width of hind wings, male 8-10, female 12 mm.

Connecticut.—Rainbow, 5 June, 1912 (H. B. K.); Killingworth, 27 June, 1920 (W. E. B.); New London, 8 June, 1921 (R. H. H.); Litchfield, 4 July, 1913, 4 June, 1925 (L. B. W.).

New England.—May 28-August.

Cordulegaster erroneus Hagen

Bulletin de l'Academie royale . . . de Belgique (2), 46: 688: 1878.

Adult, male.—Color dark brown, marked with yellow.

Head: labium light brown; labrum yellow with black ventral border; anteclypeus black, postclypeus yellow; front brown to black; vertex brown; occiput and postgenae yellow except the dorsal region below the caudal margin of the compound eyes, which is black; compound eyes meeting in a single point on the dorso-meson.

Thorax: dark brown with yellow stripes, venter lighter; prothorax, brown; dorsal cuneiform stripes of the mesepisterna entire, 1 mm. wide by 4 mm. long and rounded at the upper end; first lateral or mesepimeral stripe 1.5 by 6 mm., the second lateral 1.5 by 5 mm.; legs black with the usual spines and setae; wings with 3 cells in the anal triangle; antenodal cross-veins 19-20 in front and 14 in hind wing.

Abdomen (Fig. 13, No. 4): dark brown; second tergum with an obscure yellow ring and yellow caudo-ventral angles; there is also a small yellow spot on the caudal margin on either side about 1 mm. from the dorso-meson; tergum 3 with a transverse mesal stripe which sends an offshoot to the cephalo-ventral angles; terga 4-8 with transverse stripes 1.5 mm. wide which appear as complete (often interrupted on meson) yellow rings on these segments; 9th tergum with a touch of yellow along the cephalic margin on each side; 10th entirely black; superior anal appendages 1.5 mm. long, black, the tips pointed; ventro-mesal margin with a tooth at proximal 3d, and a basal lateral tooth beneath the overhanging margin of segment 10; accessory appendages with the anterior lamina wrinkled, bluntly pointed, the lateral depression, however, not definitely limited; hamules slender, hook-like,

about 1.3 mm. long; genital lobes broad with small marginal spines and delicate setae.

Female.—Transverse stripes on abdominal segments 4-7 interrupted on meson; ovipositor 6.5 mm. long.

Measurements: total length, male 66-75 mm.; length of abdomen, male 51-57 mm.; length of hind wings, male 45 mm.; width of hind wing, male 11-12 mm.

Connecticut.—Wallingford, 8 June, 1911 (B. H. W.).

***Cordulegaster maculatus* Selys**

Bulletin de l'Academie royale . . . de Belgique (2), 21: 105: 1854.

Nymph.—Color dark brown.

Head: labium with five lateral setae, and ten to eleven mental setae on each side, the latter composed of six longer setae on each side and four to five smaller ones; teeth at apex of median lobe each with a well-chitinized point directed laterad and the lateral margins strongly incised; mesal margins of the labial palpi each with eight to ten strong teeth; a projecting setose ridge present between the antennae; dorsum of the head behind the eyes finely tuberculate.

Thorax: legs hairy; femora short, the hind femora not extending behind segment 3 of the abdomen; wing cases extending to the caudal margins of segment 3.

Abdomen: segments 8 and 9 with small lateral spines not over one-fifth the length of the segments; ovipositor extending almost to the caudal margin of segment 9; terminal appendages of usual form, the laterals slightly less than one-fourth the length of the ventrals and the superior.

Measurements: total length, 37-40 mm.; length of lateral wing-cases, 7-8 mm.; length of hind femora, 6 mm.; length of median lobe of labium, 5-6.2 mm.

Described from one male and one female exuviae from reared specimens; one collected at Derby and emerging May 30, 1926, the other at Branford and emerging May 16, 1926.

Adult, male.—Color brown, marked with yellow.

Head: labium, postclypeus and sometimes dorsum of front brown; labrum yellow with brown ventral margin; postclypeus and cephalic surface of front yellow; vertex and dorsal margins of rear of head dark brown to black; remainder of caudal surface yellow; eyes meeting on dorso-meson in a single point, not separated.

Thorax: dark brown, with 3 yellow stripes on each side. Prothorax dark brown, the caudal margin entire; dorsal yellow stripes cuneiform, 4 mm. long, upper end widest and measuring 1 mm. across; mesepimeral or first lateral stripe 5.5 mm. long by 1.2 mm. wide, the sides parallel, ends rounded; metepimeral stripe 5 mm. long by 1.5 mm. wide, also with rounded ends and parallel sides;

venter of thorax and intersternum lighter brown than the sides; legs black, the femora, trochanters and coxae sometimes lighter, femora with two rows of irregular setae; tarsi with distal segment as long as the median and proximal together, claws about as long as the median; wings (Pl. VIII, Fig. 2) slightly flavescent; anal triangle composed of three to four cells; 2-3 cubito-anal cross-veins and a cross-vein in each triangle; supertriangle and basilar space usually free; antenodal cross-veins 17-21 in front wing and 12-15 in the hind; post-nodals 12-14 in each wing; stigma supported by 3-4 cross-veins.

Abdomen (Fig. 13, No. 2): brown or black, the following yellow: auricles of segment 2; four dorso-lateral spots (two median and two apical) on terga 2, 3 and 4, the median spots separated from each other by much less than 1 mm.; terga 5-8 with median spots only, though these are small dots at the apex of 5; cephalic margin of tergum 9 with a small transverse dash on each side; segment 10 entirely black; terga contiguous on the ventro-meson in segments 4-8. Superior anal appendages black, 1.5 mm. long, and with a large ventro-mesal tooth at middle, and another ventro-lateral tooth at base; inferior anal appendage about as wide at apex as at base; accessory appendages composed of blunt, deeply impressed cephalic lamina, and narrow hook-like hamules 1.5 mm. long.

Female.—Ovipositor about twice as long as abdominal segments 9 and 10 together. Thorax with small yellow spot behind the metathoracic spiracle.

Measurements: total length, male 65-70, female 75 mm.; length of abdomen, male 50-53, female 54 mm.; length of hind wings, male 40, female 39-45 mm.; width of hind wings, male 9-10, female 11-12.5 mm.

Connecticut.—Rainbow, 5 June, 1912 (H. B. K.); New London, 9 June, 1921 (R. H. H.); Orange, 29 May, 1922 (M. P. Z.); Storrs, 5 October, 1923, J. Cronin; Litchfield, 3, 6, and 20 June, 1925 (L. B. W.).

New England.—May 29-October 5.

***Cordulegaster obliquus* Say**

Journal of the Academy of Natural Sciences of Philadelphia, 8: 15: 1839.

Adult, male.—Color dark brown marked with yellow.

Head: labium light brown; labrum yellow with a black ventral border; anteclypeus black, postclypeus yellow, front yellow with black ventral border which is continuous with a broad, brown, preocellar stripe; vertex, occiput and postgenae, except the dorsal border behind the compound eyes, yellow.

Thorax: dark brown; venter somewhat lighter; prothorax dark, mesepisternal or dorsal yellow stripes cuneiform, 3.5 mm. long by 1.5 mm. wide at upper end; first lateral or mesepimeral stripe 5-6 mm. long by 1-1.7 wide, the ends rounded, metepimeral

similar in shape, 5 mm. by 1.5 mm.; mesonotum with a single oval spot, metanotum with two similar contiguous spots; wings clear; anal triangle 2-3 celled; 2 cubito-anal cross-veins, 1 cross-vein in the triangle, supertriangle and basilar spaces usually free, antenodal cross-veins 18-20 in front wing and 14-15 in the hind; postnodals 12-15 in front wing; legs black, lighter at base; femora with 2 irregular rows of short spinules, the front tibiae with the usual flat scales; middle and hind tibiae with the cephalic row of setae replaced by small tubercles with a small seta alongside; tarsi with apical segment as long as the two basal; tarsal claws about as long as the median tarsal segment, the ventral tooth placed beyond the middle.

Abdomen (Fig. 13, No. 3); dark brown with a yellow spot on the auricles of segment 2, and arrow-shaped yellow spots on the dorso-meson of segments 2-8; a small subcircular spot on 1 and the base of 9; segment 10 entirely black; venter of 8 with a pale spot; terga contiguous on the ventro-meson in segments 3-8; superior anal appendages short, with a ventral tooth; inferior appendage about as broad at tip as at base, the lateral angles each with two small recurved dorsal teeth; accessory appendages with cephalic lobes much wrinkled but without the distinct lateral depression; hamules slender, hook-like; genital lobes with short marginal spinules and delicate hairs.

Female.—Similar in nearly all points to the male; ovipositor about twice as long as segments 9 and 10 together.

Measurements: total length, male 63-75, female 75-78 mm.; length of abdomen, male 47-56, female 55 mm.; length of hind wings, male 42-46, female 50 mm.; width of hind wings, male 11-13, female 14 mm.

Connecticut.—Westville, 10 June, 1905 (W. E. B.); Orange, 13 June, 1922; Hamden, 19 June, 1922 (P. G.).

New England.—May 27-July 7.

Family GOMPHIDAE

Nymphs.—Flat, sprawling insects inhabiting the bottoms of slow streams and small lakes; labium flat, the mentum without a median cleft; antennae usually composed of about four segments, of which the third is greatly modified, being either much longer than any of the other segments or both longer and wider, and in some cases almost spoon-shaped; abdomen usually tapering at the caudal end, sometimes broad and flat.

Adults.—With widely separated compound eyes; the labium with mentum entire, and without a median notch; tibial spines always simple and in no case replaced by small tubercles; wings always with an oblique cross-vein behind the proximal end of the stigma; female without a long ovipositor, the vulvar lamina consisting of small lobes or plates on the ninth sternum.

For literature pertaining to the family see:

- Selys, E. de, and Hagen, H. Monograph des Gomphines, 1858: 8-460.
 ——— Bulletin de l'Academie royale . . . de Belgique (2) 7: 530-552: 1859;
 8: 162-208; 1869; 35: 732-774: 1859; 36: 492-531: 1873; 46: 408-
 471: 1878.
 Needham, J. G.—Canadian Entomologist, 29: 164-168: 1897; 29: 181-186:
 1897: pl. 7.

Key to Genera

Nymphs

1. Third segment of antennae thin and flat, almost circular in outline 2
 Third segment of antennae not thin and flat or greatly different
 from the other segments except in length¹⁴ 3
2. Abdomen nearly as broad as long, and thin and flat, with promi-
 nent dorsal hooks (Pl. III, Fig. 8) **Hagenius**, p. 127
 Abdomen not nearly as broad, or thin and flat, and without dorsal
 hooks or prominences 5
3. Middle coxae more approximate than the front coxae; proximal
 segment of the palpi not serrate on the mesal margins (Pl. v,
 Fig. 7); terminal segment of the antennae long, recurved ...
Progomphus, p. 125
 Middle coxae not more approximate than the front coxae; proxi-
 mal segment of the palpi serrate on the mesal margins; terminal
 segment of the antennae short and not recurved 4
4. Proximal segment of the labial palpi blunt at apices
Ophiogomphus, p. 129
 Proximal segment of the labial palpi with a hook at apex of the
 proximal segment or the apex decidedly pointed 5
5. Ninth abdominal segment with an acute dorsal ridge and spine at
 apex; this segment never as long as wide at base
Dromogomphus, p. 167
 Ninth abdominal segment rounded and without a sharp apical spine,
 if with a dorsal carina, then the segment as long or longer than
 wide at base **Lanthus**; **Gomphus**, pp. 138, 141, 142

Adults

1. Anal loop present in the hind wing and composed of more than
 two cells (Pl. x, Fig. 2) 2
 Anal loop absent in hind wings; composed of one or two cells (Pl.
 ix, Fig. 3) 3
2. Triangles of both wings without cross-veins; length usually less
 than 50 mm. **Ophiogomphus**, p. 129
 Triangles of both wings with a single cross-vein; length 70 mm.
 or more **Hagenius**, p. 127
3. Triangles with cross-veins; subcostal cross-vein present
Progomphus, p. 125
 Triangles without cross-veins; subcostal cross-vein absent 4
4. Hind femora with long spines interspersed with shorter ones ...
Dromogomphus, p. 167
 Hind femora naked or with rows of short spines, either uniform
 in length or gradually increasing in length from base to apex,
 never with long spines and shorter ones between
Lanthus; **Gomphus**, pp. 138, 141, 142

Genus *Progomphus* Selys¹⁵

Nymphs.—Proximal segment of labial palpus rounded at apex;
 third segment of antennae cylindrical, the fourth about as long

¹⁴ The third segment in *Ophiogomphus* is slightly flattened.

^{14a} *Erpetogomphus*, including several Southern species, is distinguished mainly by
 the long, upcurved, contiguous, inferior appendages of the male.

¹⁵ *Gomphoides* Selys.

as the third is wide; middle coxae more approximate than the front; abdomen much longer than broad; the ninth abdominal segment with or without an acute dorsal spine at apex.

Adults.—Subcostal vein present; triangles with cross-veins; anal loop absent or indistinct; occiput with an elevated ridge between the compound eyes. Hind femora at most with short spines, the femora not quite reaching the hind margin of the first abdominal segment; inferior anal appendage of the male cleft or bifid, not with divaricate arms.

***Progomphus obscurus* (Rambur)**

Histoire naturelle des insects. Neuroptères, 170: 1842.

Nymph.—Head with terminal segment of the antennae long, recurved, and about as long as the width of the preceding segment; labium as in Pl. v, Fig. 7.

Thorax: legs short, the middle coxae more approximate than the front or hind coxae; wing cases extending to the fifth abdominal segment.

Abdomen: lateral spines on segments 5 to 9 and dorsal apical hooks on 2 to 9; segment 9 about as long as wide.

Measurements: total length 27 mm.; length of abdomen 16 mm.; hind femora 2.5 mm.

Described from material in the Cambridge Museum of Comparative Zoology, and a nymph received from Dr. H. Garman, and still another in the collection of William T. Davis.

Adult, male.—Entire face brown or straw color; ocellar area brown; occiput mostly brown.

Thorax: mesepisternum with a narrow pale stripe about .5 mm. wide or less, not connected at either end with any other pale color; broad pale stripe present on the mesepimera and a small pale spot just behind the metathoracic spiracle; all of metepimera pale except the dorsal margin.

Abdomen: segment 1 brown; 2 with cephalic half pale, caudal half with a divided brown spot; 3 and 4 with narrow bilobed spots on the mid-dorsum, the cephalic lobe wider; 5 and 6 the same as 3 and 4 except that the spot in front is wider; 7 with spot reaching the lateral margins in front; 8 dark brown, obscurely marked on the sides; 9 and 10 dark brown; anal appendages with the superiors pale (straw color), darker at base, 2.5 mm. long; inferiors dark brown, about half as long as the superiors; in lateral profile the inferiors with a dorsal hook shortly in front of the apices; hamules of the second segment with curved distal hook and a transverse row of short tubercles near the base when viewed from below.

Adult, female.—Color dark brown marked with greenish yellow or olive.

Head: brown, vertex without a definite postocellar ridge as in

Gomphus. Occiput without spines, the occipital carina not sharply defined; postgenae brown.

Thorax: prothorax uniform brown, paler on sides; mesepisterna with a yellow stripe at middle and a narrower, sometimes interrupted one above the mesopleural suture; metepisterna and epimera indefinitely yellow or green and brown; legs brown, paler at base, the front femora olive beneath; femora with short spines scattered irregularly over the ventral surfaces, but arranged in two rows distally on the hind femora; tibiae carinate above and below and with two ventral rows of spines; tarsi with the third segment longer than the first two together, the claws with ventral teeth beyond the middle; wings clear with a short basal streak of brown; antenodals about 15; postnodals 9 in the front wings; stigma surmounting 6 cells in the front wing; triangle composed of 3 cells in the front and 2 in the hind wing.

Abdomen: brown with yellow spot on sides of 2 and a streak on dorsum; terga 3 with dorsal streak, 4-7 inclusive with basal spots on dorso-meson, that on 7 largest; lateral margins of 1-5 and spots on the margin of 6-8 pale; vulvar lamina composed of short, broad setose plates with an obtuse median notch; superior anal appendages pale yellowish, the tips darker, inferiors brown.

Measurements: total length, male 54, female 49-53 mm.; length of abdomen, male 39-43, female 36-43 mm.; length of hind wings, male 32, female 31-33 mm., width of hind wings, male and female 9; length of stigma, 5 mm.

New England.—June 5-August 9.

Genus *Hagenius* Selys

Nymphs.—Proximal segment of labial palpus rounded and without hook at apex; third segment of the antennae subcircular in outline; abdomen nearly as broad as long and with median dorsal hooks on segments 2-7; ninth abdominal segment without an acute apical spine on dorso-meson.

The caudo-lateral margins of the head have acute, tooth-like dorsal projections.

Adults.—Subcostal cross-vein absent; triangles with cross-veins; anal loop present consisting of 3-4 cells; vertex without an acute elevated ridge between compound eyes; dorsum of thorax brown with yellow stripes; hind femora short, extending beyond caudal margin of second abdominal segment; inferior appendage of male entire, subquadrangular caudal margin concave.

The nymphs of the one representative of this genus have been collected in small meadow brooks, though one emerging specimen was found near a small pond in the northern part of the state. The adults are strong fliers and not easily captured.

Hagenius brevistylus Selys

Bulletin de l'Academie royale . . . de Belgique, 21: 82: 1854.

Nymph (Pl. III, Fig. 8).—Color uniform dark brown or black.

Head: front declivous and with the flattened segments of the antennae forming a sort of shovel; labium with mentum as broad as long; eyes with a sharp angle on the dorsum of the head; caudo-lateral margins of the head with a flattened, dorsally projecting tooth and two smaller tubercles between these; a small angular projection beneath each compound eye on each side of the mentum. Labium as in Pl. v, Fig. 19.

Thorax: prothorax with flattened pronotum, the projecting lateral margins of which are slightly upturned; venter with a tooth beneath each coxa and a transverse ridge between them; mesosternum with a blunt tooth beneath each coxa and a transverse ridge between; there is also a sharper tooth above each mesocoxa; metacoxae with only a slight projection beneath and a ridge extending mesad from these but ending on each side about as far mesad as the inner margin of the mesocoxae; wing pads extending about to the middle of abdominal segment 4; legs with femora and tibiae triangular in cross-section, the procoxae winged below; all parts entirely without setae or spines; tarsi brown, darker at tips, the remaining portions of the legs black or brown; hind femora extending caudad to middle of the sixth abdominal segment; hind tarsi with three segments.

Abdomen: flat with lateral spines on segments 2-8, the abdomen suddenly contracted to the tip of the abdomen behind segment 8; anal appendages short, the superior flat and broad at base; the laterals about half as long as the superior and inferior appendages.

Nymph described from a female cast skin obtained at North Colebrook, Conn. The adult was found a few inches away, above the cast skin, on a tree stump. Nymphs were also taken at Orange.

Measurements: total length, 36-38 mm.; abdomen, 23 mm.; width of abdomen, 20 mm.; length hind femora, 12-13 mm.

Adult, male.—Color black or dark brown, marked with greenish yellow.

Head: mouth parts, labrum, clypeus, genae, front nearly to the level of the antennae, and a short transverse stripe on the occiput, just below the vertical ridge, yellow; remainder of the head black; dorso-mesal angles of the eyes pale; lateral ocelli each with a large pilose tubercle behind it.

Thorax: prothorax black with two small yellow spots on the dorso-meson and a spot on the pleura just above the coxae; meso- and metathorax black or dark brown with ridges behind mesostigmal plates, dorsal carina, a stripe about 1 mm. wide from the paraptera to within 1 mm. of the mesostigmal ridges on the mesanepisterna, yellow; another much narrower yellow stripe on the anepisterna near ventral border and interrupted at its caudal end;

katapisterna with ventral half yellow and a small yellow spot near dorsal border; epimerum with a stripe 2 mm. wide from wing paraptera to near cephalic margin, and a .5 mm. stripe below it to within a short distance of the spiracle; margin just above the katapisterna yellow; about ventral third of katapisterna also yellow; metepimera entirely yellow except a stripe 1-.5 mm. wide on dorsal border and the black latero-ventral margins; intersternum yellow; lateral surfaces of coxae yellow or partly yellow, remainder of legs black; all femora with short spines irregularly placed, most of them on ventral surfaces; tibiae with two rows of longer setae beneath and two shorter rows above. Tarsal claws with a tooth below nearly two-thirds the length of the claw from the base; wings as shown in Pl. ix, Fig. 4.

Abdomen: black with a mid-dorsal line of yellow on 1-7, wider on 1 and 2, and a spot on basal half of 8; caudal half of dorsal stripes sometimes obsolete. Ventral half of sides of terga 1 and 2 yellow; ventral margins of all terga except 10 with more or less yellow; ventral margins of terga 8 and 9 projecting ventrad much below the surface of the sterna. Anal appendages as in Fig. 24, Nos. 7 and 8.

Female.—Coloration similar in most features to the male but the thorax usually has more yellow; the anal margins of the wing are rounded. Ventral margins of ninth tergum separated by 4.5-5 mm.; vulvar lamina consisting of 2 broad triangular lobes 1.5 mm. long by 1 mm. wide.

Measurements: total length, male 74, female 74 mm.; length of abdomen, male 54, female 53 mm.; length of hind wing, male 49, female 49-51 mm.; width of hind wing, male 13-14 mm.; female 12-13 mm.; length of stigma, male 5.5, female 5.5-6 mm.

Connecticut.—East Haven, 19, 24 June, 1908 (B. H. W.); North Colebrook, 19 June, 1920 (P. G.); Litchfield, 17 July, 1910, 3 July, 1916 (L. B. W.).

New England.—June 15-September 3.

Genus *Ophiogomphus* Selys

Nymphs.—Proximal segment of the labial palpus rounded at apex; third segment of antennae flattened, nearly equal in width throughout; fourth segment short, its length not equal the width of the third segment; middle legs not more approximate than the front legs; abdomen considerably longer than broad, and with very small dorsal projections sometimes with hooks; ninth abdominal segment without an acute dorsal apical spine.

Adults.—Wings without subcostal vein; triangles without cross-veins; anal loop consisting of three to four cells; occiput with a distinct occipital ridge between the compound eyes, and sometimes tooth-like projections besides; dorsum of thorax green or yellow with brown markings; hind femora with very short spines, and

reaching only to caudal margin of the first abdominal segment; inferior anal appendages of the male bifid.

Literature dealing with *Ophiogomphus* has been published by:
Woodruff, L. B. Journal of the New York Entomological Society, XXII: 61-63: 1914 (Nymph).
Needham, J. G. Canadian Entomologist 29: 166: 1897, pl. VII: 31: 233-238: 1899, pl. v.
Bromley, S. W. Entomological News 35: 343-344: 1924, pl. xi.
Calvert, P. P. Entomological News 35: 345-346: 1924, pl. xi.

The classification of this genus is in a very unsatisfactory condition, probably due to the unusual variation in the characters commonly relied upon. A thorough study of the group is needed, based on numerous specimens of each species, which should include both sexes properly associated. Until this is done the identification of our Eastern *Ophiogomphi* will remain a very uncertain proposition.

Like other members of the family, the genus *Ophiogomphus* has the peculiar habit of apparently emerging in large numbers in certain localities and then disappearing quickly—a sort of explosive dispersal or disappearance. Only in a few cases have they been found in large numbers. According to Woodruff the nymphs inhabit small clear brooks with sandy bottoms.

Key to Species Nymphs¹⁶

- | | |
|------------------------------------|----------------------|
| 1. Dorsal spines rudimentary | aspersus |
| | rupinsulensis |
| | carolus |
| Dorsal spines prominent | colubrinus |
| | mainensis |

Adults, Males¹⁷

- | | |
|---|----------------------|
| 1. Inferior anal appendage viewed from below with arms not greatly widened at apices and without an angle on the dorsal surface in lateral view | 2 |
| Inferior anal appendage viewed from below with arms greatly widened at apices; or with an angle on dorsal surface in lateral view | 3 |
| 2. Accessory genitalia as in Fig. 16, No. 7; wings slightly flavescent or yellowish | howei |
| Accessory genitalia as in Fig. 14, No. 10; wings clear | anomalus |
| 3. Inferior anal appendages narrower than the superiors and invisible when viewed from above | 4 |
| Inferior anal appendages wider than the superiors and visible from above | 5 |
| 4. Metapleural suture lined with black; superior anal appendages as in Fig. 14, No. 3 | aspersus |
| Metapleural suture not lined with black; superior anal appendages as in Fig. 14, No. 2 | rupinsulensis |

¹⁶ Nymphs of *howei* and *anomalus* are unknown.

¹⁷ *Colubrinus* adults are distinguished from others mainly by the black stripe present on the front at base of antennae.

5. Inferiors either without strongly upturned teeth or the margin between the teeth very irregular; internal angles of inferiors entire **carolus**
 Inferiors with strongly upturned teeth, the margin between them regular in fully mature specimens; inferiors appendages with tuberculate internal angles **mainensis**

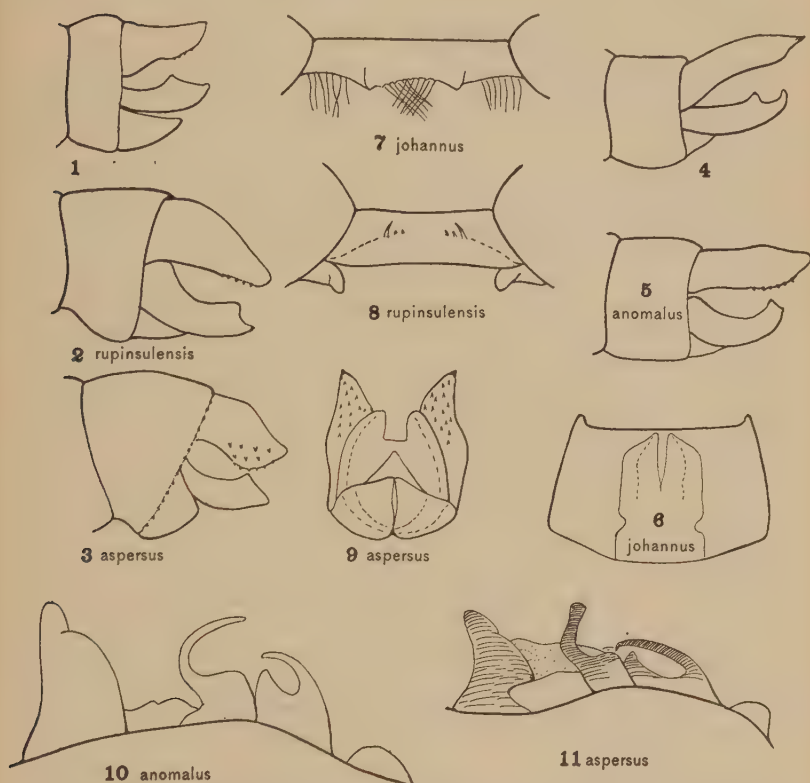


FIG. 14. *Ophiogomphus*, structural details. 1. *O. carolus*, anal appendages. 2. *O. rupinsulensis*, anal appendages. 3. *O. aspersus*, anal appendages. 4. *O. mainensis*, anal appendages. 5. *O. anomalus*, anal appendages. 6. *O. johannus*? vulvar lamina of supposed female in collection of Philadelphia Acad. Nat. Sciences. 7. Occiput of same. 8. *O. rupinsulensis*, occiput. 9. *O. aspersus*, ventral view of anal appendages. 10. *O. anomalus*, accessory appendages, lateral view. 11. *O. aspersus*, accessory appendages in lateral view.

Females

1. Occiput with long, usually contiguous spines (Fig. 16, A) 2
 Occiput without long contiguous spines 3
 2. Terga 8 and 9 with U-shaped spots **anomalus**
 Terga 8 and 9 without U-shaped spots **mainensis**

3. Postgenae with conspicuous horns (Fig. 14, No. 8)*rupinsulensis*
- Postgenae without conspicuous horns 4
4. Wings flavescent; length of abdomen 22 mm.*howei*
- Wings clear; length of abdomen 32-35 mm. 5
5. Black stripe present on the metapleural suture*aspersus*
- No black stripe present on the metapleural suture*carolus*

Ophiogomphus aspersus Morse

Psyche, 7: 209: 1895.

Nymph.—Rudimentary dorsal hooks on abdominal segments 2 to 9, longest on 2; wing-pads extending to the middle of segment 4.

Measurements: total length, 24 mm.; length of abdomen, 15 mm.; greatest width of abdomen, 7 mm.

Adult, male.—Color yellow or greenish and black.

Head: yellow except the ocellar area and stripe on front, which are dark.

Thorax: pale with a narrow dark stripe on the mesopleural suture and another a little above on the episternum, the latter not reaching the wing bases, sometimes shoulders of mesepimera dark; metapleural suture dark; middle and hind femora pale on cephalic surfaces, darker at tips, and with short spines below not in rows; tibiae brown or sometimes black, lighter above, with double row of spines beneath, and two spinigerous ridges above; tarsi and claws black; wings clear, slightly smoky.

Abdomen: with yellowish green dorsal marks, widened considerably on terga 2-9 at the base but not reaching the apices of those segments; segment 10 and the anal appendages brown, 10 sometimes with a lanceolate yellow dorsal spot nearly as long as the segment; terga 8 and 9 with large lateral spots on each, the margins of 3-7 streaked with yellow; sides of 1 and 2 also pale; superior anal appendages (Fig. 14, Nos. 3 and 9) denticulate beneath; the inferiors bifurcate, each arm being narrow at tip, and blunt, not broadened. Accessory appendages are shown in Fig. 14, No. 11.

Female.—Vulvar lamina two-thirds as long as 9, bifid for a little more than half its length; occipital horns slender, brown; occipital spines present in contact or very near the compound eyes.

Measurements: total length, male 45-49, female 44 mm.; length of abdomen, male 32-35, female 30-32 mm.; length of hind wings, male 26-28, female 26-27 mm.; width of hind wings, male 8-8.5, female 8 mm.

Described from a male taken at Saranac, N. Y., July 27, 1900, by L. W. Sweet, sent to the writer by Mr. C. W. Johnson; notes on additional material in collection of Dr. Calvert.

New England.—May 26-August 29.

Ophiogomphus colubrinus Selys

Bulletin de l'Academie royale . . . de Belgique, 21: 40: 1854.

Nymph.—Similar to *mainensis*. Labium as in Pl. v, Fig. 11.

Adult, male.—Color black and yellow or green.

Head: yellow, front with black transverse stripe at middle, lower margin also black.

Thorax: pale stripe of the mesepisterna broad, and connected at the posterior end with the pale streak above the suture; femora pale, the dorsal carinae and tips only black.

Abdomen: pale spots on dorsum of segments 1 to 10 and also on the lateral margins of the segments, that on segment 9 U-shaped; inferior anal appendage with contiguous arms, the tips upcurved; accessories with tips of the hamules about the same length as the basal broader portion and only slightly curved.

Female.—Vulvar lamina about three-fourths the length of segment 9, the tips in contact; occipital spines not in contact and not separated by their own length at base.

Measurements: total length, male 41, female 42 mm.; length of abdomen, male 26, female 25 mm.; length of hind wings, male 27, female 29 mm.

The male differs from most other species of the genus in the accessories, which are similar to *aspersus*. The black stripe on the front is characteristic of both sexes.

Described from a male and female in the Museum of Comparative Zoology collection.

Ophiogomphus anomalus Harvey

Entomological News, 9: 60: 1898.

Adult, male.—Color yellow or greenish and black.

Head: pale, black as follows: all of labrum except large lateral spots, frontoclypeal suture, a transverse stripe on the front, and another on the dorsum in front of the ocelli; ocellar area dark; occiput pale.

Thorax: pale, with brown mid-dorsal stripe, a brown stripe at mesopleural suture enclosing a pale streak, and brown mesepimeral shoulders; brown marks of the shoulders, extending caudad to the spiracle; coxae pale, remainder of the legs brown. Wings slightly clouded.

Abdomen: dark brown with yellow on terga as follows: sides of 1, auricles and margins of 2; cephalo-lateral angles of 8, a U-shaped mark on sides of 9; sides and venter of segment 10 pale; dorso-mesal pale spots on 8, 9 and 10 also yellow, variable; superior anal appendages (Fig. 14, No. 5) tuberculate below; arms of the inferior viewed from below entire, not much wider at tips than at base. Accessory appendages as in Fig. 14, No. 10.

Female.—Occiput with two long, very closely placed spines on

occiput, and small spines on the postgenae behind the occipital ridge; wings clear. Some females have pale streaks on the lateral margins and dorsum of terga 2-8 inclusive, and the spot on the margin of 9 is not U-shaped as in the male.

Measurements: total length, male 39-44, female 39-44 mm.; length of abdomen, male 30, female 28-30 mm.; length of hind wing, male 24, female 25-26 mm.

New England.—June 6-June 15.

*Ophiogomphus carolus*¹⁸ Needham

Canadian Entomologist, 29: 183: 1897.

Adult, male.—Color yellow or greenish and black.

Head: greenish yellow; the vertex and caudal margin of the front black; occiput yellow.

Thorax: yellow with dark stripe on the dorsal carina, another on mesopleural suture, and a shorter one just above the latter on the mesepisternum, not, however, reaching the wing bases; shoulders of the mesepimera also dark.

Abdomen: with yellowish green dorsal marks widened considerably at base on terga 2-9, but not reaching the apices of those segments; segment 10 yellow with basal dark spot on dorsum, 9 with a large lateral spot on each side; anal appendages spinose beneath; arms of the inferior appendage much wider at tip than at base, and with a lateral tubercle.

Female.—Occiput with two rather closely placed spines which may, however, be wanting (Needham, Can. Ent. 29, Pl. VII, Figs. 1-4; 1897).

Measurements: total length, male 43, female 45 mm.; length of abdomen, male 30, female 30 mm.; length of hind wings, male 24, female 27 mm.; width of hind wings, female 8 mm.

¹⁸ Woodruff collected in Connecticut a large series of supposed *Ophiogomphus johannus* Needham. On examination I was surprised to find that the females of the series did not run to *johannus*, in a key based on specimens in the Philadelphia Academy of Natural Sciences and the Museum of Comparative Zoology at Cambridge. Specimens were sent to Dr. Calvert and as a result of his findings as well as due consideration the following notes were made:

Ophiogomphus johannus.—Differs from *carolus* mainly in the shape of the hamules. Female in Philadelphia collection may not be *johannus*, but *carolus*, except for the denticles between the occipital spines. Referred to *johannus* by Harvey on supposition. Figures of male appendages given by Williamson, Ent. News 13, pl. iii, Figs. 3-5.

Ophiogomphus carolus.—Differs from *johannus* in accessories; female apparently different from *mainensis* in occipital spines which are not contiguous (Needham Can. Ent. 29, pl. vii, Figs. 1-4).

Ophiogomphus mainensis.—Occiput of female type near Woodruff's specimens except for occipital horn, which is, however, similar to some specimens of Woodruff's which have a small horn. Male not known certainly. Supposed male in M. C. Z. collection is the same as *carolus*. Female may be either *anomalus* or *johannus* but rejected by Calvert from *anomalus* because of character of occipital spines.

O. johannus described from male only. Female not known certainly. Woodruff had both sexes.

O. mainensis described from female only. Male not known certainly.

O. carolus, both sexes described, both differing from *johannus* and *mainensis* according to various authors.

The only way out of the difficulty (pending further researches) seems to lie in the elimination of one of these species, which should probably be *johannus*.

Needham's measurements of the types are: length, 40-42 mm.; abdomen, 28-31; hind wing, 24-26 mm. Can. Ent. 29: 183: 1897.

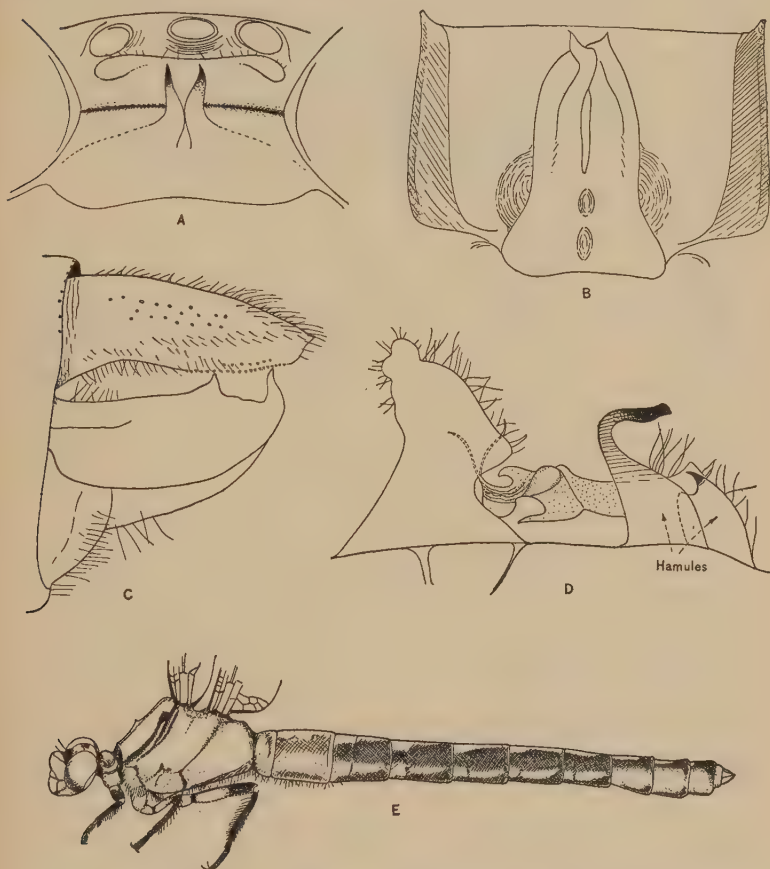


FIG. 15. *Ophiogomphus mainensis*. A. Dorsum of head behind the ocelli showing occipital spines. B. Vulvar lamina of female. C. Lateral view of male anal appendages (teneral); the tips of the inferiors of mature specimens are better represented in Fig. 14, No. 4. D. Accessory appendages of male. E. Lateral view of female showing color pattern of thorax and abdomen.

Ophiogomphus howei Bromley

Entomological News 35: 343-347: 1924, Pl. xi.

A species closely related to *anomalus* but much smaller. The original figures are reproduced in Fig. 16. Recorded from Massachusetts and Pennsylvania.

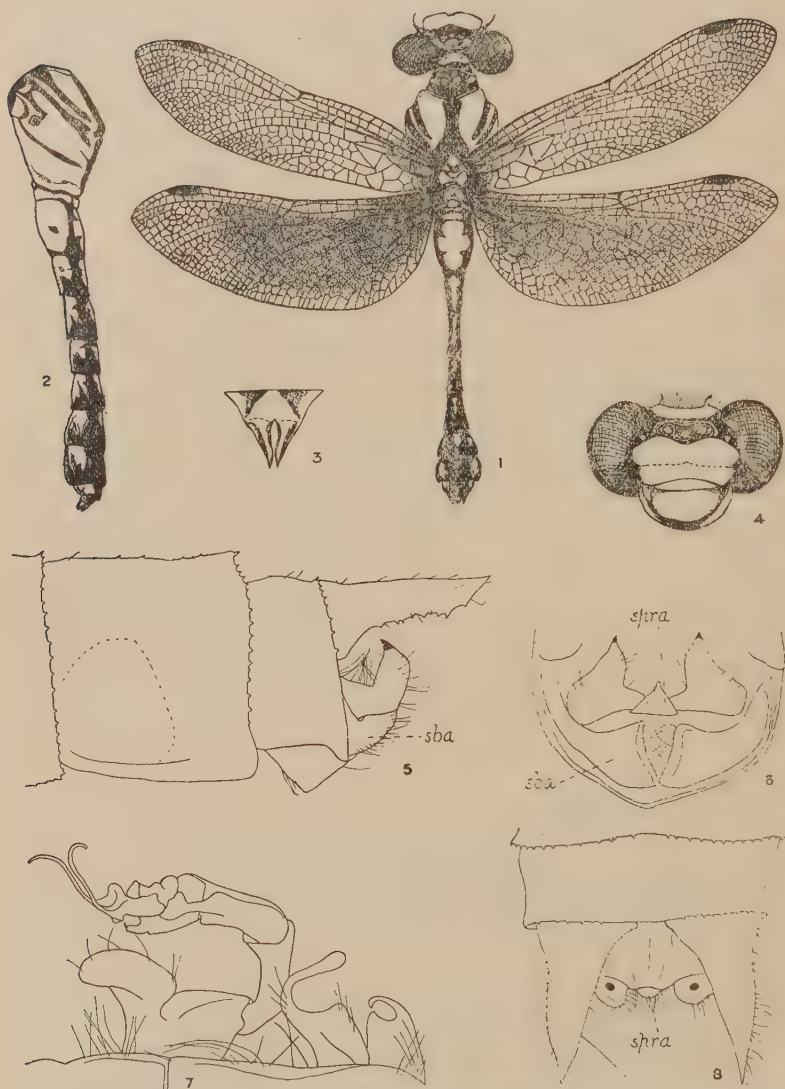


FIG. 16. *Ophiogomphus howei*. 1. Dorsal aspect, showing color pattern. 2. Lateral aspect of thorax and abdomen showing color. 3. Vulvar lamina. 4. Frontal aspect of head, showing position of occipital horns. 5. Left lateral aspect of the hind end of the abdomen; the dotted line on segment 9 shows the outline of the yellow spot. 6. Caudal aspect of the same, ventral parts only. 7. Left lateral aspect of the genitalia of the second abdominal segment. 8. Dorsal aspect of the hind end of the abdomen. In figs. 5, 6, and 8 the black-tipped apices of the inferior appendage furnish good landmarks for comparison; sba, subanal lamina; spr, supra-anal lamina. (From Calvert and Bromley.)

Ophiogomphus mainensis Packard¹⁰

Proceedings of the Entomological Society of Philadelphia, 2: 255: 1863.

Nymph.—Labium as in Pl. v, Fig. 4; third antennal segment almost oval, the fourth segment rudimentary; dorsal surface of the head minutely tuberculate.

Thorax: legs short, very hairy, the hind femora each with a glabrous scar on the external surface from base to near the distal end.

Abdomen: without prominent hooks but with knobs on 2, 3, and 4, those on segments 5 to 9 projecting a little more and resembling hooks or teeth, but not reaching the caudal margin of the segments except that of 9; lateral spines wanting, but replaced by blunt projections on segments 8, 9 and 10; lateral terminals very wide at base, a little more than half as long as the superiors and inferiors, which are about equal in length; abdomen in front of segment 10 divided into thirds by two longitudinal impressed lines on the ventral surface.

Measurements: total length, 23-25 mm.; abdomen, 14-15 mm.; width of abdomen, 7 mm.; length of hind femora, 4-5 mm.; dimensions of segment 9, 5 mm. broad by 1.25 mm. long.

Adult, male.—Color yellow and dark brown or black.

Head: labrum pale with brown or black margins; a dark streak on the front at ocelli; ocellar area dark; occiput yellow.

Thorax: yellow, with a dark mid-dorsal stripe, another over the mesopleural suture and another shortly dorsad, which may or may not be united with the sutural stripe; metapleural suture narrowly lined with black; wings clear, or smoky.

Abdomen: sides of terga 1 and 2 pale on sides, 3 pale on sides at base, pale dorsal stripes on 1-3, dorsal streaks or spots on 4-8, sides of 8, 9 and 10 broadly pale, the pale spots sometimes including a black spot on 8 and 9; anal appendages denticulate or tuberculate below; arms of the inferior appendage straight, cylindrical, seen from below the apices considerably widened, divided at tips (Fig. 15, C).

Female (Fig. 15, E).—Occiput as in Fig. 15, A, the spines long and contiguous a short distance from the bases, though varying in this respect, being more nearly parallel or the tips crossed in some preserved specimens; vulvar lamina (Fig. 15, B) nearly as long as segment 9, the median notch a little more than half the length of the plates.

Measurements: total length, male 42-45, female 43-46 mm.; length of abdomen, male 28-30, female 30-31 mm.; length hind wings, male 25-26, female 27-28 mm.; width of hind wings, male 7-8, female 8.5-9 mm.

Connecticut.—Litchfield, 4 June, 1925, and various other dates (L.B.W.); Milford, 13 June, 1922 (W. E. B.).

New England.—May 27-July 11.

¹⁰ *Johannus* Needham, Can. Ent. 29: 182: 1897. See footnote, p. 134.

Ophiogomphus rupinsulensis (Walsh)

Proceedings of the Academy of Natural Sciences of Philadelphia, 388: 1862.

Adult, male.—Color yellow or greenish and black.

Head: yellow except ocellar area, which is dark brown; labium pale.

Thorax: pale with exception of a narrow dark stripe on the mesopleural suture and another above on the anepisternum, the latter not reaching the wing bases; femora light at base, darker at tips, and with short spines below, not in rows at bases; tibiae brown, lighter above, with a double row of spines beneath, and two spinigerous ridges above; tarsi and claw black; wings clear.

Abdomen: yellow, obscurely marked with black near the apices and along the sides of the terga; terga 8 and 9 much expanded and in some specimens 5 to 6 times as wide as 3 and 4; anal appendages as in Fig. 14, No. 2, yellow; superior anal appendages spinose beneath.

Female.—Color similar to the male.

Head: occiput with two widely separated spines on the dorsal surface (Fig. 14, No. 8) and two very heavy projections below the occipital ridge on each side; vulvar lamina a little more than three-fourths as long as the ninth sternum, and with a median cleft about half their length.

Measurements: total length, male 50-52, female 45-47 mm.; length of abdomen, male 35-36, female 32-34 mm.; length of hind wings, male 28-30, female 29-30 mm.; width of hind wings, male and female, 9 mm.

Described from specimens in collection of P. P. Calvert, Philadelphia, Pa.

Connecticut.—Salisbury, 13 June, 1926 (P. G.).

New England.—June 13-August.

Genus *Lanthus* Needham

Nymphs.—Proximal segment of labial palpus not truncate; third antennal segment flattened conspicuously; middle coxae not more approximate than the front; no dorsal projections on abdomen; ninth segment without an acute spine at apex.

Adults.—Subcostal vein absent; triangles without cross-veins; anal loop indistinct; vertex without acute ridge between compound eyes; dorsum of thorax brown; hind femora extending beyond the caudal margin of the first abdominal segment; inferior anal appendages of the male with widely divaricate arms.

Adults of *Lanthus* are so closely allied to *Gomphus* species that they are separated only with difficulty. The nymphs, however, are fairly distinct and the genus is retained mainly on this account.

For key to species see combined key p. 142 of *Gomphus* and *Lanthus*.

The nymphs of this genus are found in small swift-flowing brooks, usually in shady situations. Adults are apparently rarer than the nymphs and it is probable that the species have the explosive dispersal habit of their near relatives.

Lanthus albistylus Hagen

Bulletin de l'Academie royale . . . de Belgique, 46: 460: 1878.

Nymph (Pl. III, Fig. 9).—Color dark brown.

Head: median lobe of labium gradually contracted behind the middle; apical tooth of the proximal segment of the labial palpi not produced and hardly distinguishable from the teeth of the mesal margin (Pl. v, Fig. 5). Third segments of the antennae greatly enlarged, spoon-like, and about three times the width of the proximal segments, the fourth segment minute and inconspicuous.

Thorax: legs with tips of femora pale, the wing-cases extending to the middle of the fourth abdominal segment in full-grown specimens.

Abdomen: flattened, with only rudimentary lateral spines on segments 8 and 9; width of the ninth abdominal segment more than twice as great at front margin as at the hind; no dorsal spines or prominences.

Measurements: total length, 19 mm.; length of abdomen, 11 mm.; length of hind femora, 2 mm.; length of median lobe of labium, 2 mm. long by 1.8 mm. wide.

Described from a male exuviae, the adult emerging June 3, 1922; collected at Orange, Conn.

Adult, male.—Color yellow and black.

Head: yellow and black, the following black: ventral and dorsal margins of the labrum, and a mark on the meson half the length of the sclerite; furrows between ante- and postclypeus; all of front including ocellar area, except an elongate transverse area in front of the antennae (2 by .5 mm.); and all of vertex except a small spot on caudal surface between the compound eyes and another caudad of the ocelli on the vertex, the latter sometimes absent; all of occiput and postgenae dark; compound eyes separated by .9 mm., measured on the transverse epicranial suture.

Thorax: pronotum black with two small mesal spots, a lateral spot on each side and portions of the cephalic margin green; propleura pale; meso- and metathorax mostly yellow; anepisterna of mesothorax dark brown, with two yellow stripes, and a yellow collar, the dorsal stripe 1.5 mm. long by .4 mm. wide, the lateral stripe 2 by .3 mm., and contracted in the middle, sometimes interrupted; mesopleural suture sometimes with a pale line; ventral half of the katepisterna yellowish green; mesepimera entirely green except the narrow brown margins; metapleura green; venter pale (Fig. 22, No. 18); legs black, with coxae and tro-

chanters pale, the front femora pale below; venter of femora with scattered spines not in definite rows; wings clear with 10-12 antenodals in the front wing, 6-7 in the hind; 6-9 postnodals in front and 6-9 in the hind wing.

Abdomen: black or dark brown, the following pale: ventral half of the lateral surface of terga 1 and 2; a dorsal mesal stripe on 1 and 2 and a basal spot on 3; lateral spots at the base of terga 4-8, the lateral areas on 7 and 8 sometimes indefinite; superior anal appendages yellow, the tips sometimes greenish, the two together forming a distinct lyre-shaped figure; inferior appendage brown, nearly as long as the superiors, each of the two arms half as long as the entire appendage.

Female.—Yellow of the male usually replaced by green or greenish yellow. Vulvar lamina (Fig. 20, No. 3) consisting of two short lobes (.3 mm. long) united on the meson for half their length, their tips evenly rounded; ventral margins of terga 9 separated by .7 to 1.0 mm.; superior anal appendages green or pale, .5 mm. long and pointed at tips; length of terga 7, 8, 9 and 10 measured on the dorso-meson, 2.5, 1.5, 1 and .5 mm. respectively.

Measurements: total length, male 35, female 31 mm.; length of abdomen, male 24-25, female 21-25 mm.; length of hind wings, male 20, female 20 mm.; width of hind wings, male 6.5, female 7 mm.

Connecticut.—Guilford, 13 July, 1920; Orange, May, 1922 (P. G.).
New England.—June 24-August 1.

Lanthus parvulus (Selys)

Bulletin de l'Academie royale . . . de Belgique, 21: 56: 1854.

Adult, male.—Color yellowish green and black.

Head: yellow with dorsal and ventral margins of the labrum and a stripe between front and clypeus black; vertex and occiput mostly black, with pale spots in front of the ocelli, and small spot on caudal surface of the occiput.

Thorax: pronotum black, with two small mesal spots, a lateral spot on each side and portions of the cephalic margin pale; mesothorax with less yellow or green than *albistylus*, with a median streak and caudal spot on each episterna, and a faint yellow line above the mesopleural suture; legs entirely black, wings clear.

Abdomen: nearly all black, with yellow on the sides of segments 1 and 2, and sometimes a trace on 9; anal appendages black; in lateral profile the dorsal surface of the superiors is nearly straight, the ventral surface has a basal tubercle; in dorsal view the lateral surfaces are gently curved but never sigmoid as in *albistylus*.

Female.—The vulvar lamina (Fig. 20, No. 2) are nearly two-thirds as long as the ninth sternum, the median notch is broad and the apical points well separated; length about 1 mm.

Measurements: total length, male 35-36, female 40 mm.; length of abdomen, male 26-28, female 28 mm.; length of hind wings, male 22-26, female 25-26 mm.; width of hind wings, male 7, female 8 mm.

Described from one female and two males in the collection of P. P. Calvert, Philadelphia Academy of Sciences.

Connecticut.—Cornwall, 16 July, 1913, 28 June, 1918, 8 June, 1923 (L. B. W.).

New England.—May 26-July 1.

Genus *Gomphus* Leach

Nymphs.—Proximal segment of labial palpus not truncate; third antennal segment cylindrical; middle coxae not more approximate than the front; no dorsal projections on abdomen; ninth segment without an acute spine at apex.

Adults.—Subcostal vein absent; triangles without cross-veins; anal loop indistinct or consisting of a single cell; vertex with or without an acute ridge between compound eyes; dorsum of thorax brown, with green or yellow stripes or yellow with brown stripes; hind femora with short spines of nearly equal length; hind femora extending beyond the caudal margin of the first abdominal segment; inferior anal appendages of the male bifurcate, the arms usually widely divaricate.

Another genus with the rapid dispersal habit. Cast exuviae have been frequently seen in large numbers along the borders of streams or small lakes, but no amount of collecting would apparently reveal the adult. The nymphs most commonly inhabit small streams with muddy bottoms into which they burrow and attach to their bodies all manner of rubbish for the purpose of concealment. They are with a few exceptions found on the wing early in summer—May, June or early July—and are most commonly encountered near the streams where the nymphs are found. The eggs of most species are probably laid by the dipping process while the insect is in flight.

Various authors have attempted to divide *Gomphus* into a number of groups, but thus far the subdivisions are apparently not distinct enough to warrant splitting the genus. The following groups are offered as an aid to making determinations, but it is realized that they do not agree fully with those of previous authors. They apply only to species found in the northeastern United States.

1. *Brevis* and *abbreviatus* fall into one group, distinguished by small size and color pattern, and structure of the nymph (p. 149).
2. A miscellaneous and not entirely homogeneous group comprising *exilis*, *descriptus*, *spicatus*, and *lividus*, distinguished by the fairly slender abdomen of the adults, not at all expanded. Nymphs of typical form shown in Pl. III, Fig. 7 (p. 151).
3. The pale thorax types including *villosipes*, *furcifer*, *pallidus*, and possibly *borealis*, though the latter may belong in 2. The nymphs of this group have comparatively long teeth on the labial palpi (p. 157).

4. A group comprising *scudleri*, *amnicola* and *notatus*, in which the median pale stripe of the mesepisternum is isolated and not connected with the pale thoracic collar, and the nymphs of which are provided with obliquely truncate teeth on the labial palpi (Pl. v, Figs. 12, 17, 18; p. 160).
5. The expanded abdomen types including *crassus*, *graslinellus*, *fraternus*, *ventricosus*, *vastus*, and *externus*. The nymphs are provided with prominent lateral spines and the ninth segment is not elongate, but wide in proportion to its length. Probably *dilatatus*, *lineatifrons* and *quadricolor* also belong here (p. 162).
6. A group containing *plagiatus* and *spiniceps*, characterized by their very long slender abdomens in the adult stage, and the elongate terminal segments of the nymphal abdomen, particularly segment 9 (p. 166).

The species *G. abditus* described by Miss Butler from Massachusetts is apparently most closely related to *lividus* but it is difficult to determine just where it belongs from the original description. No collectors have taken this species since its description in 1914 (Can. Ent. 46: pp. 347-348). It is omitted from the present paper. *Quadricolor* and *adelphus* are also omitted.

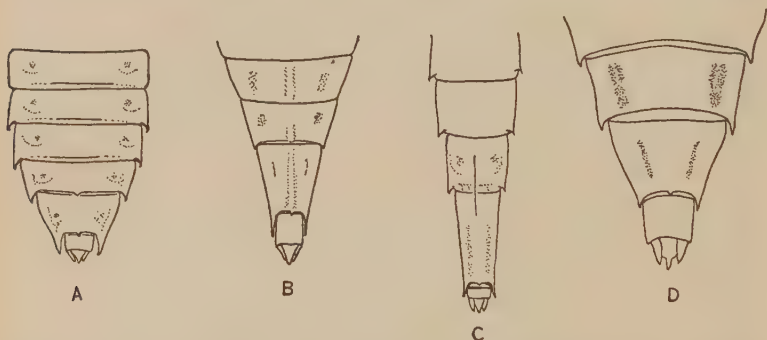


FIG. 17. Tips of abdomens of *Gomphus* nymphs (A, B, and C, after Needham). A. *G. fraternus*. B. *G. pallidus*. C. *G. spiniceps*. D. *G. lividus*.

Gomphus and Lanthus

Key to Species

Nymphs

1. Third antennal segment subcircular; no dorsal hooks, ridges or prominences on the abdomen 2
- Third antennal segment not subcircular; either dorsal hooks, ridges or prominences usually present on the abdomen 3
2. Length full grown about 19 mm. (Pl. III, Fig. 9) (Lanthus) *albistylus*
- Length full grown about 23 mm. (Lanthus) *parvulus*
3. Segment 9 twice as long as wide at base; length full grown over 40 mm. *spiniceps*
- Segment 9 over twice as long as wide at base; length full grown less than 40 mm. 4
4. Dorsal ridge present on caudal abdominal segments; teeth of palpi long, sharp, and about equal in length to the terminal fixed hook; segment 9 as long as wide or only slightly shorter 5

- Dorsal ridge absent on caudal abdominal segments; teeth of palpi short, sometimes blunt, and not equal in length to the terminal fixed hook; length of segment 9 never more than three-fourths the width at base 7
5. Palpi each with 6 teeth (Pl. v, Fig. 8) **villosipes** 6
Palpi each with 7 teeth (Pl. v, Fig. 6) 6
6. Length of segment 10 half that of segment 9 **pallidus**
Length of segment 10 more than half segment 9 **furcifer**
7. Dorsal prominences only on segment 9; teeth of palpi usually less than 6 and obliquely truncate 8
Dorsal prominences on segments 3, 6, 7, or 8 to 9; if indistinct on 8 and 9 and not present on other segments, then the teeth of labial palpi not obliquely truncate; teeth of palpi usually more than 6 10
8. Distal margin of mentum between the palpi concave (curving proximad) **plagiatus**
Distal margin of mentum straight 9
9. 3 teeth on palpi (Pl. v, Fig. 12) **notatus**
4 teeth on palpi (Pl. v, Fig. 18) **scudderi**
5 to 6 teeth on palpi (Pl. v, Fig. 17) **amnicola**
10. Lateral spines of segment 9 as long or longer than segment 10 ... 11
Lateral spines of segment 9 shorter than segment 10 15
11. Lateral spines of abdominal segment 9 twice as long as those of 8; abdomen more than three times as long as broad 13
Lateral spines of abdominal segment 9 equal in length to those of 8; abdomen about twice as long as broad, never three times ... 12
12. Lateral spine on the sixth abdominal segment less than half the length of the one on the seventh segment **abbreviatus**
Lateral spine on the sixth abdominal segment more than half the length of the one on the seventh segment **brevis**
13. Terminal fixed hook of palpus not well developed (Pl. v, Fig. 2) 14
Terminal fixed hook of palpus well developed (Pl. v, Fig. 13) .. **vastus; crassus**
14. Lateral spines of segment 9 more than twice as long as segment 10; distal margin of the mentum convex (**externus**)
Lateral spines of segment 9 less than twice as long as segment 10; distal margin of the mentum straight **fraternus**
15. Dorsal prominences on abdominal segments 3 or 4 to 9 16
Dorsal prominences on abdominal segments 6 or 7 to 9 17
16. Teeth of labial palpi 6-8 **lividus**
Teeth of labial palpi 8-10 **descriptus; graslinellus**
17. Length full grown 28-31 mm.; teeth on labial palpi 6-9 **spicatus**
Length full grown 19-24 mm.; teeth on labial palpi 4 **exilis**

Adults, Males

1. Compound eyes 1 mm. apart at the dorso-mesal angles or less; occipital ridge absent or represented by a line of hairs in some 2
Compound eyes more than 1 mm. apart at the dorso-mesal angles; occipital ridge present, distinct 4
2. Superior anal appendages toothed below in lateral profile **brevis**
Superior anal appendages not toothed below 3
3. Superior anal appendages pale; viewed from above the lateral margins are sigmoid (**Lanthus**) **albistylus**
Superior anal appendages black; viewed from above the lateral margins are not sigmoid (**Lanthus**) **parvulus**
4. Abdomen not over 32 mm. long 5
Abdomen more than 32 mm. long 7
5. Ventral margins of the superior anal appendages, seen from the side, entire **exilis**

- Ventral margins of the superior anal appendages seen from the side with a tooth (Fig. 21, Nos. 15, 18) 6
6. Superior anal appendages as in Fig. 21, No. 15; occipital ridge prominent **abbreviatus**
Superior anal appendages as in Fig. 21, No. 18; occipital ridge not prominent **brevis**
7. Ventral margins of terga 8 and 9 convexly rounded, extending ventrad considerably and not in line with the margins of segments 3 to 6 (Fig. 18, b), terminal segments expanded 14
Ventral margins of terga 8 and 9 not extending ventrad, noticeably, and in line with the margins of 3 to 6 (Fig. 18, a); terminal segments not or very little expanded 8
8. Abdomen 45 mm. long or more 9
Abdomen less than 45 mm. long 10
9. Last three segments of the abdomen reddish brown; superior appendages of the male with a lateral angle in dorsal view **plagiatus**
Last three segments not entirely reddish brown; superior appendages of the male without a lateral angle in dorsal view **spiniceps**
10. Superior anal appendages without sharp teeth on lateral, ventral or mesal surfaces; without a distinct angle on lateral surfaces when viewed from above **exilis**
Superior anal appendages with a tooth on either lateral, ventral or mesal surfaces; if without conspicuous teeth, then with a decided angle on lateral surfaces when viewed from above 11

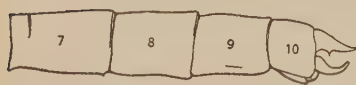
a *Gomphus spicatus*b *Gomphus ventricosus*

FIG. 18. Last four segments of males of *Gomphus spicatus* and *G. ventricosus*, showing differences in the structure of segment 8.

11. Superior anal appendages show a tooth on the venter when viewed in lateral profile 12
Superior anal appendages do not show a tooth on the venter, when viewed in lateral profile **lividus**
12. Dorsal view of the superiors shows a tooth on side of each, none on the mesal surfaces **spicatus**
Dorsal view of the superiors shows teeth on the sides and also on the mesal surfaces 13
13. Mesal tooth of the superiors sharp **borealis**
Mesal tooth of the superiors rounded **descriptus**
14. Mesepisterna dark with pale stripes (half, or more than half dark) 17
Mesepisterna pale with dark stripes 15
15. Occiput with a sharp elevation at center **villosipes**
Occiput without a sharp elevation at center 16
16. Hind femora pale **pallidus**
Hind femora black **furcifer**
17. Dorsal pale stripes of the mesepisterna not connected with the mesothoracic half collar 18
Dorsal pale stripes of the mesepisterna connected with the mesothoracic half collar 20
18. Abdomen with basal pale rings on segments 3-6 **scudderi**
Abdomen without basal pale rings on segments 3-6 19
19. Lateral pale stripe of the mesepisterna reduced to a line of dots or wanting **amnicola**
Lateral pale stripe of the mesepisterna very distinct **notatus**

20. Metepisterna infuscated; dorsum of abdominal segment 9 with a broad yellow dorsal stripe **graslinellus**
 Metepisterna not infuscated; dorsum of abdominal segment 9 without a broad yellow dorsal stripe 21
21. Fronto-clypeal suture usually with a black stripe; labrum with black; yellow spots of abdominal segment 8 less than half the length of that segment; anal appendages as in Fig. 23, Nos. 14, 15 **crassus**
 Fronto-clypeal suture without a black stripe; no black on the labrum or very little; yellow spot on abdominal segment 8 more than half the length of that segment 22
22. Pale stripes of the mesepisterna about equal in width **vastus**
 Pale stripes of the mesepisterna very unequal in width 23
23. Hamule of the second abdominal segment with a prominent angle at middle when viewed from the side (Fig. 21, No. 5) **fraternus**
 Hamule of the second abdominal segment without a prominent angle at middle when viewed from the side 24
24. Superior anal appendages as in Fig. 23, Nos. 12, 17 (**externus**)
 Superior anal appendages as in Fig. 21, No. 9 **ventricosus**



FIG. 19. Tip of abdomen of *Gomphus ventricosus* from above showing expanded condition and color pattern.

Females

1. Occiput rounded and without a distinct superior transverse ridge.. 2
 Occiput with a distinct superior transverse ridge 5
2. Compound eyes 1 mm. apart or less at their dorso-mesal angles .. 3
 Compound eyes more than 1 mm. apart at their dorso-mesal angles 4
3. Superior anal appendages black; vulvar lamina more than half as long as the ninth sternum (Fig. 20, No. 2) ... (**Lanthus**) **parvulus**
 Superior anal appendages pale; vulvar lamina less than half as long as the ninth sternum (Fig. 20, No. 3) .. (**Lanthus**) **albistylus**
4. Vulvar lamina more than half as long as the ninth sternum, the sides concave and the plates slender distad (Fig. 20, No. 4); a black stripe on the fronto-clypeal suture **brevius**
 Vulvar lamina less than half as long as the ninth sternum, the sides convex and not more slender distad (Fig. 20, No. 1); no black stripe on the fronto-clypeal suture **abbreviatus**
5. Abdomen 45 mm. or more in length **spiniceps**²⁰
 Abdomen less than 45 mm. in length 6
6. Ventral margins of terga 8 and 9 nearly straight, when viewed from the side, not extending further ventrad than 3 to 6 and usually parallel with the margins of those segments 14

²⁰ Vulvar lamina longer than broad, the tips rounded **lineatifrons**
 Vulvar lamina broader than long **spiniceps**
Plagiatus also falls here but is distinguished by the reddish-brown color of the abdomen, the caudal segments being nearly uniform brown. *Externus* is a western species not found in New England.

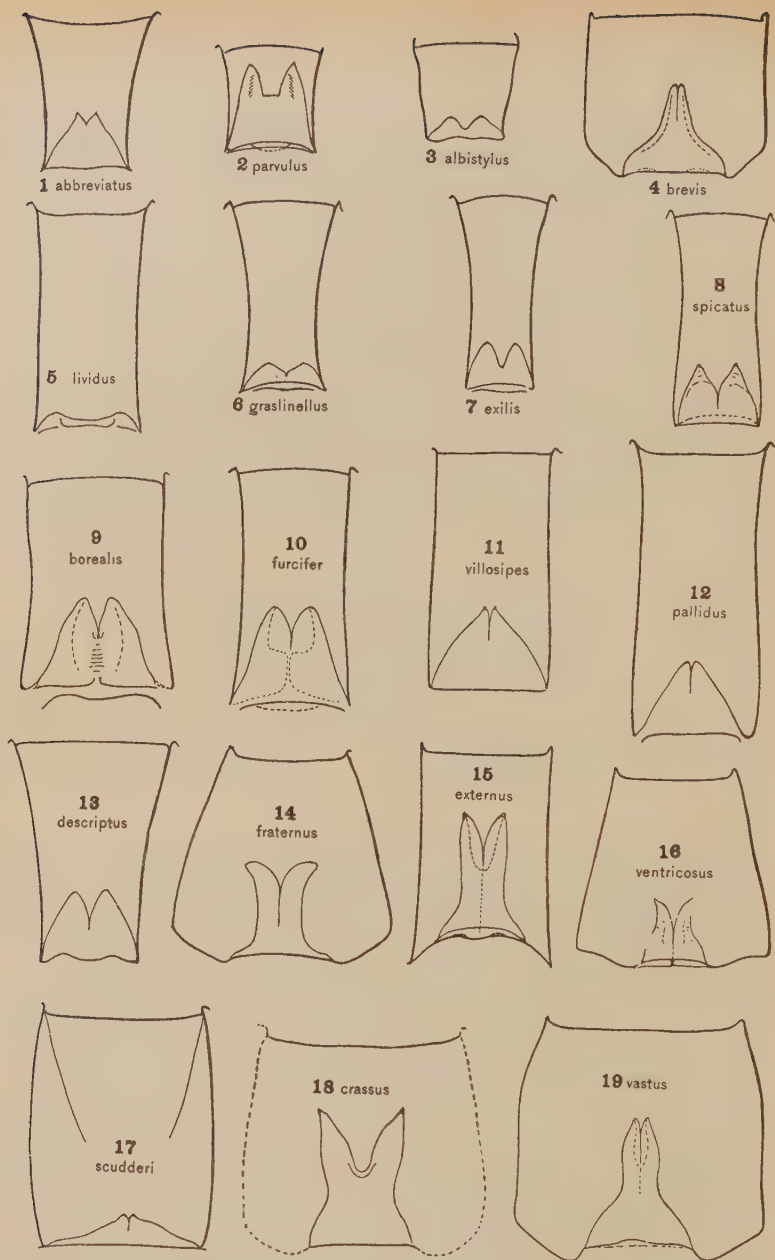


FIG. 20. Vulvar lamina of *Gomphus* and *Lanthus* species. 1. *Gomphus abbreviatus*. 2. *Lanthus parvulus*. 3. *L. albistylus*. 4. *Gomphus brevis*. 5. *G. lividus*. 6. *G. grasinellus*. 7. *G. exilis*. 8. *G. spicatus*. 9. *G. borealis*. 10. *G. furcifer*. 11. *G. villosipes*. 12. *G. pallidus*. 13. *G. descriptus*. 14. *G. fraternus*. 15. *G. externus*. 16. *G. ventricosus*. 17. *G. scudderi*. 18. *G. crassus*. 19. *G. vastus*. These structures will be found on the ventral surface of abdominal segment 9 of the different species.

- Ventral margins of terga 8 and 9 not straight, when viewed from the side but convexly rounded and the margins of 8 and usually 9 extending ventrad further than the preceding segments; the lateral margins of 8 and 9 not parallel with the margins of 3 to 6 7
7. Vulvar lamina wider than long; mesal stripes of mesepisterna not connected with mesothoracic collar (Fig. 22, No. 2, 4, 6) 12
- Vulvar lamina decidedly longer than wide; stripes of mesepisterna connected with mesothoracic collar 8
8. Lateral margins of the vulvar lamina with a median notch or indentation, constricted at one-third their length (Fig. 20, No. 18) **crassus**
- Lateral margins of the vulvar lamina without a median notch, not constricted at one-third their length 9
9. Tips of the vulvar lamina directed strongly laterad **fraternus**
- Tips of the vulvar lamina not directed strongly laterad 10
10. Tips of the vulvar lamina in contact **vastus**
- Tips of the vulvar lamina distinctly separated at tips 11
11. Vulvar lamina half or two-thirds as long as segment 9 ... (**externus**)
- Vulvar lamina less than half as long as segment 9 **ventricosus**
12. Abdomen with pale basal rings on segments 3 to 6; thorax with most of the metapleura infuscated (Fig. 22, No. 6) **scudderi**
- Abdomen without pale basal rings on segments 3 to 6; thorax with most of the metapleura pale (Fig. 22, No. 4) 13
13. Metapleural suture with a dark line; dorsal basal spots of terga 3 to 8 very small **notatus**
- Metapleural suture without a dark line; dorsal spots on base of terga 3 to 8 elongate and with a tendency to form stripes on the dorso-meson **amnicola**
14. Mesepisterna pale with darker stripes, more than half dark 15
- Mesepisterna dark with pale stripes, more than half pale 18
15. Occipital ridge depressed at center (Fig. 21, No. 21) **borealis**
- Occipital ridge not depressed at center 16
16. Occipital ridge usually with a denticulate spine at middle ... **villosipes**
- Occipital ridge without a denticulate spine at middle 17
17. Transverse ocellar ridge not as long as the anterior margin of the occiput and not as long as the transverse line connecting the outer (lateral) margins of the two lateral ocelli **furcifer**
- Transverse ocellar ridge as long as the anterior margin of the occiput and as long as the transverse line connecting the outer (lateral) margins of the two lateral ocelli **pallidus**
18. Length of the abdomen not over 31 mm. **exilis**
- Length of the abdomen more than 31 mm. 19
19. Each plate of the vulvar lamina longer than wide (Fig. 20, No. 7); without a broad median notch between the two plates 20
- Each plate of the vulvar lamina shorter than wide (Fig. 20, No. 5); with a broad median notch between the two plates 23
20. Occiput as in Fig. 21, Nos. 19, 21, the ridge depressed at center .. 21
- Occiput as in Fig. 21, No. 20, the ridge not depressed at center .. 22
21. Pale stripe of the mesepisterna more than half the width of that sclerite; metepisterna heavily infuscated; occiput as in Fig. 21, No. 19 **descriptus**
- Pale stripe of the mesepisterna less than half the width of that sclerite; metepisterna not heavily infuscated; occiput as in Fig. 21, No. 21 **borealis**
22. Occipital ridge nearly straight; a pointed tubercle laterad of each lateral ocellus; length of abdomen 28 to 32 mm. **exilis**
- Occipital ridge elevated at center; pointed tubercle beside each lateral ocellus usually absent; length of abdomen 33-36 mm. **spicatus**



FIG. 21. *Gomphus* species, accessory genitalia and anal appendages of males and occipita of females. 1. *G. notatus*, accessory genitalia. 2. Same of *G. amnicola*. 3. Anal appendages of *G. spicatus* from above. 6. Same from the side. 4. *G. lividus*, accessory genitalia. 5. *G. fraternus*. 7. *G. graslinellus*. 8. *G. villosipes*. 9. *G. ventricosus*, lateral view of anal appendages. 10. *G. borealis*, accessory appendages. 11. *G. descriptus*. 12. *G. graslinellus*, lateral view of anal appendages. 13. *G. pallidus*, accessory appendages. 14. *G. spicatus*. 15. *G. abbreviatus*, lateral view of anal appendages. 16. *G. vastus*, accessory appendages. 17. *G. crassus*. 18. *G. brevis*, lateral view of anal appendages. 19, 20, 21. Occipita of *descriptus*, *spicatus*, and *borealis*, females.

23. Hind margin of occiput strongly convex, barely emarginate in the very middle of the convexity **lividus**
 Hind margin of the occiput almost straight, or but slightly bisinuate so as to form three lobes, the median lobe slightly higher than the two lateral lobes, and not emarginate at its middle **graslinellus**

Group I BREVIS-ABBREVIATUS Group

Gomphus abbreviatus Hagen

Bulletin de l'Academie royale . . . de Belgique, 46: 464: 1878.

Nymph.—Measurements, 23-24 mm., length of abdomen, 14 mm., width, 6.5 mm., femur, 5 mm.

Similar in nearly all points to the nymph of *brevis*, according to Needham.

Adult, male.—Color yellow and black.

Head: clypeus, labrum and labium, yellow or pale; front with a dark stripe on the dorsal surface in front of ocelli; occiput yellow with a sharp ridge.

Thorax: pronotum with 2 small mesal spots of yellow and a larger spot on each side; meso- and metathorax black, marked with yellow, the mesepisterna with a rather narrow yellow stripe connecting with the mesothoracic half collar, and a line above the mesopleural suture; legs black.

Abdomen: black with yellow on dorso-meson and sides of terga 1 and 2, 4-7 with yellow spots at base, 8 and 9 with triangular spots on sides, the last (8 and 9) segments expanded; superior anal appendages dark brown with a conspicuous tooth beyond middle on the ventral surface (Fig. 21, No. 15); dorsal margins of the superiors nearly straight.

Female.—Color the same as the male.

Occiput without a distinct ridge as in most Gomphi; a prostrate spine present caudad of each lateral ocellus; vulvar lamina broad, the sides convex, the apical teeth small and median notch shallow (Fig. 20, No. 1).

Measurements: total length, male 42, female 40 mm.; length of abdomen, male 30, female 28 mm.; length of hind wings, male 23, female 25 mm.; width of hind wings, male 7, female 8 mm.

Described from specimens in collections of P. P. Calvert, in Philadelphia Academy of Natural Sciences.

Gomphus brevis Hagen

Bulletin de l'Academie royale . . . de Belgique (2), 46: 460: 1878.

Nymph.—Similar in size and shape to nymphs of *Ophiogomphus*. Labium shown in Pl. v, Fig. 10; palpi with fixed hook hardly longer than the teeth of the mesal margins.

Abdomen: of the general type shown in Fig. 17, A, the lateral

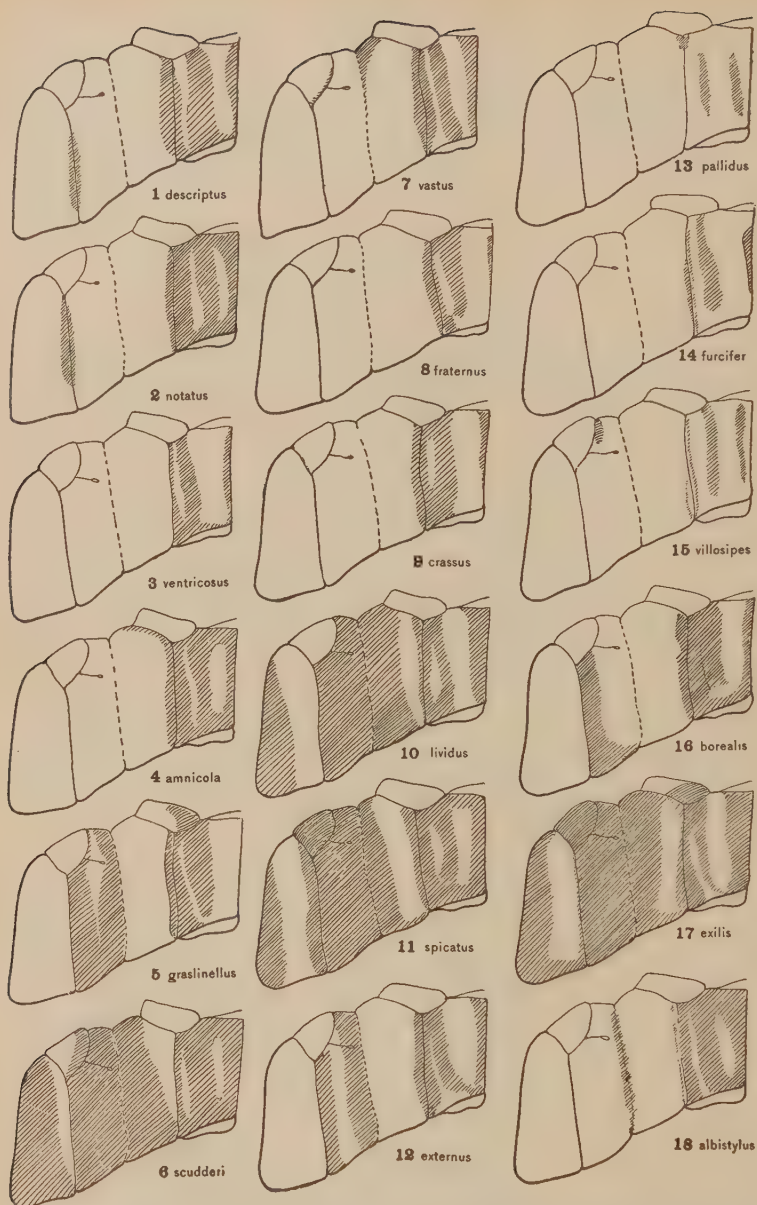


FIG. 22. Color pattern of the meso- and metathorax of *Gomphus* and *Lanthus* species. 1 to 17. *Gomphus*. 18. *Lanthus*. Only the pleura are shown opened out and each figure includes an area between the dorsal carina and the lateral carina just above the intersternum or post-coxal area. The ventral surfaces are not shown, or the notal areas between the wing bases.

scars not conspicuous, though present and not divided into separate areas by lines of hairs; lateral spines present on segments 6-9 inclusive, that of segment 9 nearly or quite as long as segment 10 measured on the dorso-meson; lateral terminal appendages three-fourths as long as the inferiors.

Measurements; exuviae: total length, 23 mm.; length of abdomen, 14 mm.; greatest width, 6.5 mm.; length of hind femora, 5 mm.; width of segment 9 on front margin, 4 mm.; hind margin, 2.5 mm.; length measured on the dorso-meson, 1.5 mm.; length of segment 10, 1 mm.

Connecticut.—Two exuviae collected at Colebrook, 19 June, 1920.

Adult, male.—Color black and green.

Head: clypeus, labrum, and labium pale yellow; front with dorsal dark stripe in front of ocelli, vertex yellow and with a distinct ridge.

Thorax: pronotum with 2 small mesal spots and a lateral spot on each side; mesepisterna with a broad yellow stripe connecting with the half-collar by its full width, a narrow pale stripe above the suture and a small spot cephalad of the wing bases; legs black.

Abdomen: black; segments 1 and 2 with yellow on the dorso-meson and on sides; 8 and 9 with yellow triangular spots on sides; 4-7 with dorsal yellow spots at base; 8 and 9 expanded; superior anal appendages (Fig. 21, No. 18), with a conspicuous tooth at middle.

Female.—Similar to the male; vulvar lamina (Fig. 20, No. 4) long and slender; abdomen with yellow spots on cephalo-lateral angles of 4-7 inclusive, and yellow lines on meson of 2-5; abbreviated yellow lines on 6 and 7 and spots on 8 and 9 at bases, which may, however, be wanting.

Measurements: total length, male 40, female 43 mm.; length of abdomen, male 28, female 30 mm.; length of hind wings, male 25, female 25-26 mm.; width of hind wings, male 7, female 8 mm.

Connecticut.—Litchfield, 1 July, 1916; 10 June, 11 July, 1924 (L. B. W.).
New England.—May 31-July 8.

Group 2 EXILIS-DESCRIPTUS Group

Gomphus descriptus Banks

Journal New York Entomological Society, 4: 194-195: 1896.

Nymph.—According to Needham, the nymph of this species has the third antennal segment depressed and somewhat widened apically; labium with mentum having the distal margin nearly straight, fringed with flat hairs but unarmed; palpi with terminal hook of proximal segment regularly incurved, and with six to eight teeth before it on the inner margin.

Abdomen: lateral spines on segments 6-9 sometimes obscured by tufts of hairs on the sixth segment, those on the ninth segment

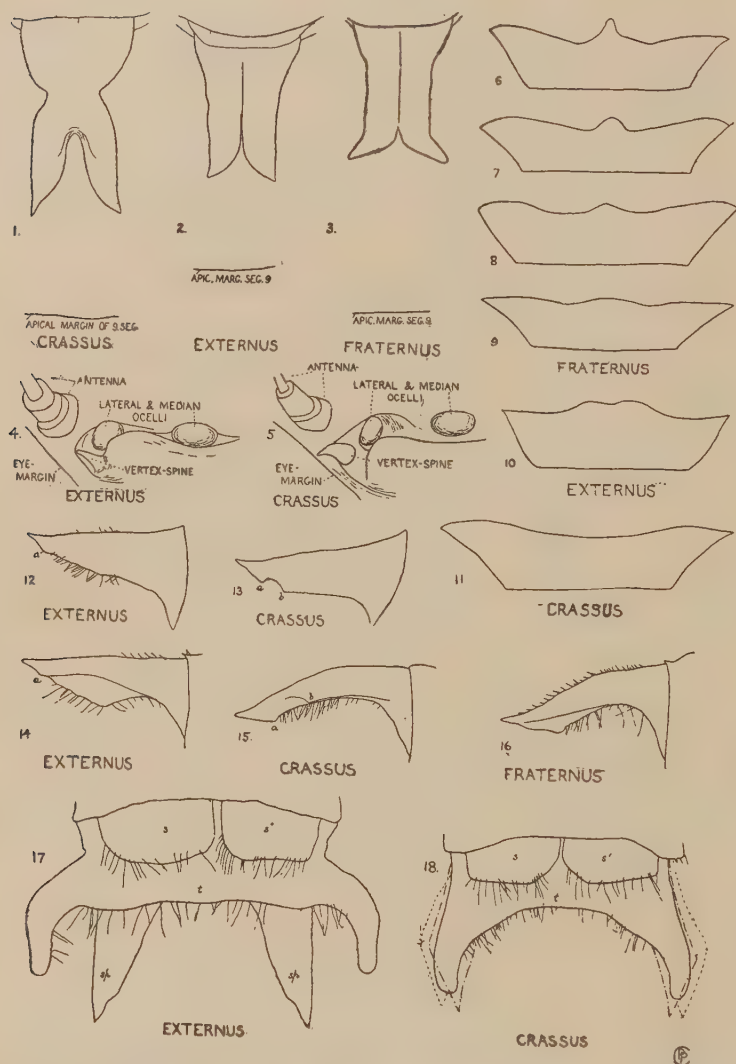


FIG. 23. Structural details of *Gomphus fraternus*, *crassus* and *externus*. 1-3, vulvar lamina. 6-11, occipital margins. 12-16, right superior anal appendages in lateral profile. 17 and 18, Anal appendages, ventral aspect. (From Calvert, Ent. News, 12; pl. III; 1901.)

short; hardly surpassing the base of the tenth segment, straight but not closely oppressed; tenth segment half as long as the ninth and a little shorter than the appendages; dorsal hooks represented by low inconspicuous rudiments on segments 3-9, with traces of the median impressed line on the anterior end of the middle segments.

Measurements: total length, 32 mm.; length of abdomen, 20 mm., width 7 mm.; length of hind femora, 5.6 mm.

Description from Needham 1901, p. 454.

Adult, male.—Color brown marked with greenish yellow.

Head: greenish yellow except ocellar area and a transverse line on the front; rear of head pale on sides, remainder brown.

Thorax: meso- and metathorax as in Fig. 22, No. 1, the mesepisterna each with a variable yellow stripe and streak above the mesopleural suture; interpleural and metapleural sutures lined with black.

Abdomen: brown, terga 2-7 with a pale mesal line, 8 with a mesal spot at base; about half the lateral surfaces of terga 1-3 and 9 pale; obscure lateral marks on 4-8; superior anal appendages in dorsal view show teeth on lateral and mesal surfaces, that on the mesal surface sharply outlined.

Female.—Vulvar lamina consisting of subtriangular plates a little less than one-third the length of segment 9 (Fig. 20, No. 13); occipital ridge depressed at center (Fig. 21, No. 19) as in *borealis*; in general with more pale color than the male.

Measurements: total length, male 49, female 50 mm.; length of abdomen, male 34, female 35 mm.; length of hind wings, male 20, female 32 mm.; width of hind wings, male 8, female 8.5 mm.

Described from material in collection of P. P. Calvert.

Gomphus exilis Selys

Bulletin de l'Academie royale . . . de Belgique, 21: 55: 1854.

Nymph (Pl. III, Fig. 7).—Color dark brown.

Head: labium with median lobe as broad as long, contracted behind the middle, the lateral margins nearly parallel; palpi with about 6 teeth on the mesal margin; antennae with the third segment longer than all the rest together; cylindrical, not flattened.

Thorax: wing-pads extending to the fourth abdominal segment.

Abdomen: lateral spines on segments 6 to 9 inclusive, the ninth segment twice as long as the tenth, the spine of the ninth half, or less than half as long as the tenth segment; width of the ninth abdominal segment at caudal margin, measured inside the spines, less than the length on the dorso-meson; dorsum with distinct sharpened dorsal hooks on segments 6 to 9 and prominences on 3 to 6.

Measurements: total length, full grown, 23 mm.; length of median lobe, 3.5 mm. wide by 2.5 mm. long; length of hind femora, 4.5 to 5 mm.

Adult, male.—Color brownish black marked with dull greenish yellow.

Head: yellowish except the area bounded by the transverse epicranial suture, compound eyes, and a transverse line drawn immediately in front of the antennal bases, this area being dark brown; dorsal margin of the postgenae behind the compound eyes, black.

Thorax: brown with greenish olive stripes as in Fig. 22, No. 17; meso- and metanota pale; coxae, trochanters, dorsum of tibiae and sometimes the first two segments of hind tarsi, pale.

Abdomen: dark brown, with a linear pale streak on dorso-meson on terga 1-10 approximately 1 mm. wide on segments 1 and 2, almost obsolete on 7-9; lateral margins of terga 1, 2, 7, 8, 9 and cephalic half of 3, yellow; small spots also on cephalo-lateral angles of terga 4-7. Anal appendages with the superiors in dorsal view tapering to a point; in lateral profile the appendage suddenly widened at basal third, tapering from there to tip; length 1.3 mm.; inferior appendage with divaricate arms arising from a wide plate, the tips of the arms upturned; accessory appendages in lateral profile consisting of a narrow (.25 mm. wide) black, cephalic lamina with an apical tooth directed caudad on each; a flat (.5 mm. wide) hamule, the proximal two-thirds equal in width, thence narrowed to the caudal margin forming a strong black hook.

Female.—Similar to the male in color.

Head: the caudo-dorsal margins of the occiput between the compound eyes nearly straight; postocellar ridge somewhat thickened at the lateral ends and a little curved; a lower semi-circular ridge extending around the lateral ocellus, with a pointed tubercle in the middle opposite the ocellus; dorso-mesal angles of the compound eyes separated by 1.5 mm.; vulvar lamina (Fig. 20, No. 7) composed of two flat contiguous plates with rounded tips; length of segments 7, 8, 9 and 10 measured on dorso-meson 3, 2.2, 2.2, and 1 mm. respectively.

Measurements: total length, male 41-43, female 39-43 mm.; length of abdomen, male 28-32, female 28-31 mm.; length of hind wings, male 23-25, female 23-25 mm.; width of hind wings, male 7.5, female 8.5-9 mm.

Connecticut.—New Haven, 27 May, 1903, 23 May, 1906 (B. H. W.); West Thompson, 12 July, 1905 (H. L. V.); Westville, 2 June, 1908; Mount Carmel, 6 June, 1908 (B. H. W.); Colebrook, 19 June, 1920; Hamden, 30 May, 1922 (P. G.); Litchfield, 30 May, 1909 (L. B. W.).

New England.—May 19-August 8.

Gomphus lividus Selys

Bulletin de l'Academie royale . . . de Belgique, 21: 53: 1854.

Nymph.—Labium as shown in Pl. v, Fig. 16.

Similar in general form to *Dromogomphus spinosus* as shown in Pl. III, Fig. 6.

Abdomen with short lateral spines on segments 7 to 9 inclusive, that on 9 one-third as long as segment 10; dorsal hooks rudimentary, present as indefinite elevations on segments 4-7 inclusive; segment 9 not elongate, 4 mm. wide at base and 2 mm. at hind margin; length measured on dorso-meson 2.5 mm.; segment 10 cylindrical, short (1 mm.), about as long as the terminal appendages; lateral scar on each side of dorsum of 9 long and narrow, nearly as long as the segment; group of three scars on each side of 8, and five to six scars each in a closely associated group on each side of segments 4 to 7 inclusive.

Measurements: total length, 31 mm.; length of abdomen, 19 mm.; greatest width of abdomen, 7 mm.; length of hind femora, 6 mm.

Described from exuviae of a reared specimen in the American Museum of Natural History reared by Mr. L. B. Woodruff and bearing the label "Litchfield VI: 10: 24."

Adult, male.—Color brown and olive.

Head: face yellow, including labium, labrum, clypeus and front; ocellar area brown; occiput pale; postgenae brown to black, paler on sides.

Thorax: meso- and metathorax obscurely marked; the mesepisterna each with a broad pale stripe at middle, which usually connects with the mesothoracic half-collar; a narrow pale stripe above the mesopleural suture, and another on each mesepimera from shoulders to wing-bases; metepisterna smoky; dorsocephalic half of metepimera pale.

Abdomen: dark brown to black, pale on sides of terga 1, 2, and base of 3; pale mid-dorsal streak on 1-5 or 6, and spots at the base of terga 7 and 8; dorsum of 10 and sometimes 9 olive; legs brown; tibiae pale above; anal appendages black, the superiors in dorsal view with a lateral angle, in lateral view the ventral margins with a rounded projection near apex of each.

Female.—Femora uniform brown; margin of occiput nearly straight, depressed at center; terga with obscure margins; length of terga 8, 9 and 10 measured on dorsum, 3, 3, and 1 mm. respectively; vulvar lamina (Fig. 20, No. 5) short, only one-seventh as long as sternum 9, the plates rounded and separated at tips by a broad obtuse emargination.

Measurements: total length, male 50, female 50 mm.; length of abdomen, male 34-35, female 35-36 mm.; length of hind wings, male 29-30, female 29-34 mm.; width of hind wings, male 8, female 9 mm.; length of stigma, male 2.5-3.5, female 3-3.5 mm.

Connecticut.—One female taken in Westville, June 2, 1908, by Mr. B. H. Walden, belongs here. Winsted, 13 June, 1926 (P. G.); Cornwall, 7 June, 1925 (L. B. W.).

Gomphus spicatus Hagen

Bulletin de l'Academie royale . . . de Belgique, 21: 54: 1854.

Nymph.—Head: labium as in Pl. v, Fig. 15,²¹ distal margin of the mentum between the palpi convex and with a thin fringe of flattened setae; fixed hook of the palpi bent strongly mesad, and with about 7 short teeth on the inner margin.

Abdomen: tapering (Fig. 17, D) with conspicuous lateral scars, those on 4-8 inclusive divided into several irregular conspicuous areas by lines of hairs; scars on each side of 9, linear; segment 10 almost glabrous; segment 9 with a minute dorsal projection on the hind margin, but none on preceding segments, lateral spines present on segments 7, 8 and 9, that on 9 two-fifths as long as segment 10; lateral terminal appendages four-fifths as long as the ventrals.

Measurements; full-grown nymph: total length, 25 mm.; length of abdomen, 15 mm.; width of abdomen, 6 mm.; greatest width segment 9, 3.5 mm.; length on mid-dorsum, 2.25 mm.

Nymph collected at Colebrook, Conn., 19 June, 1920.

Adult, male.—Color olive-brown marked with greenish yellow.

Head: greenish yellow except the black area bounded by post-ocellar ridge or epicranial suture, compound eyes and transverse line cephalad of the antennae, rear of head yellow below, dark brown or black above.

Thorax: dark brown, with olive marks as in Fig. 22, No. 11; venter pale gray, legs with brown coxae and trochanters, and proximal two-thirds of the dorsa of the tibiae pale.

Abdomen: segment 3 considerably contracted in the middle; terga 2-7 with a pale mesal line, which, however, is obscured towards the caudal margins of 5, 6 and 7; terga 8 with a spot on cephalic margin on meson; about half the lateral surfaces of terga 1, 2, 3, and 9, yellow or pale; obscure lateral marks on 4-8; venter of abdomen black; segments 7, 8, 9, and 10 measured on dorso-meson, 3.5, 3, 2.5, and 1 mm. long. Superior anal appendages (Fig. 21, Nos. 3, 6) viewed from above, pointed, divaricate, the mesal margins nearly straight, lateral margins broken, forming a tooth just proximad of the mid point; in lateral profile the superiors with a sharp ventral tooth opposite the tooth of the lateral margin; inferior appendage with slender upcurved arms joined to a rather narrow basal plate, the tips of the arms black; superior appendages 1.5 mm. long; accessory genitalia consisting of very slender black cephalic lamina with two teeth at tips; hamules flat, distal half narrowed to a hook (Fig. 21, No. 14).

Female.—Color and color pattern similar to the male.

Head: postocellar ridge almost W-shaped, the lateral ends considerably higher than the rest of the ridge; semicircular ridges

²¹ The variations in the nymphal labia of this species have been described by Miss Stout, Entomological News 29: 68-70: 1918.

around the lateral ocelli and ends of the postocellar ridge, inconspicuous and without a tubercle at middle. Compound eyes separated by 1.5 mm. measured on the transverse epicranial suture. Occipital margin elevated at middle, and rounded, the sides sloping gently to the compound eyes.

Thorax: as in the male.

Abdomen: lateral marks more distinct than the male and forming an obscure lateral strip on each side of terga 2-8; length of terga 7, 8, 9 and 10 measured on the dorso-meson 3.6, 2.6-3, 2.6, and 1 mm.; vulvar lamina (Fig. 20, No. 8) consisting of two pointed lobes, contiguous on the meson and measuring about .8 mm. in length by .4 in width; ventral margins of the 9th terga separated by .8-1.4 mm. Superior anal appendages slightly more than 1 mm. in length, sharply pointed at tip.

Measurements: total length, male 48, female 46 mm.; length of abdomen, male 34-36, female 33-36 mm.; length of hind wings, male 26-27, female 27-28 mm.; width of hind wing, male 7.5-8, female 7.5-8 mm.

Connecticut.—Colebrook, 19 June, 1920 (P. G.); Litchfield, 26 June, 27 July, 1909 (L. B. W.).

New England.—May 15-July 13.

Group 3 VILLOSIPES-PALLIDUS Group—Pale Thorax Types *Gomphus borealis* Needham

Bulletin of the New York State Museum, 47: 454: 1900.

Adult, male.—Color dark brown to black and greenish yellow or olive.

Head: face including labium, labrum, clypeus and front, except a black preocellar stripe, pale; ocellar area black; occiput pale, postgenae black, sides pale.

Thorax: pronotum with 3 yellow spots and yellow caudal margin; color pattern of mesothorax and metathorax as in Fig. 22, No. 16, the mesepimeral stripes usually connected with the pale collar; streak above the mesopleural suture usually short; metepisterna more or less infuscated, the amount of infuscation variable; metepimera pale.

Abdomen: terga 2 and 7 with a pale mesal line, which is obscured toward the caudal margins of 5, 6 and 7; terga 8 with a mesal spot on cephalic margin; terga 8, 9 and 10 measured on the dorso-meson 2.8, 2.5, and 1 mm. in length respectively; accessory genitalia as in Fig. 21, No. 10.

Female.—Sides of abdominal segments 1 and 2, pale and obscure pale stripes on 3-7 inclusive, the latter remote from the margins; lateral margins of terga 8 and 9 and venter of segment 10 pale; vulvar lamina, Fig. 20, No. 9, one-third to nearly one-half as long as the ninth sternum, the plates sub-triangular and

an acute median notch between; occipital ridge depressed at center (Fig. 21, No. 21).

Measurements: total length, male 47, female 44-49 mm.; length of abdomen, male 34, female 32-35 mm.; length of hind wings, male 25, female 29 mm.; width of hind wing, male 8, female 8.5 mm.; length of stigma, female 3.5-4 mm.

One specimen without definite record in collection of the Connecticut Agricultural Experiment Station.

Gomphus furcifer Hagen

Bulletin de l'Academie royale . . . de Belgique (2), 46: 458: 1878.

Adult, male.—Color yellow and black or dark brown.

Head: face yellow; postgenae black above, pale below.

Thorax: pronotum with 3 pale spots on mesal lobe; caudal margin pale; front and hind femora pale beneath; meso- and metathorax (Fig. 22, No. 14) pale with short dorsal stripe on each mesepisterna next the dorsal carina, and another just above the mesopleural suture; neither of the stripes on mesepisterna reach the wing bases; mesopleural suture infuscated; a patch of infuscation on shoulders of the metepisterna.

Abdomen: with pale stripes on dorso-meson of 1-7 inclusive; indistinct or wanting on 8, 9 and 10; lateral margins of terga greenish, the color reduced to elongate spots on 4-6; superior anal appendages yellow, showing a tooth in lateral profile.

Female.—Abdomen with pale stripes on dorsum of 1-7 inclusive, and broad (about 2 mm. wide) pale margins sometimes enclosing a black spot on 3-7, or with a dark stripe dividing the pale marks, connecting with the dark of the caudal margins; a broad pale lateral stripe on 8 and 9 not remote from the margin, segment 10 pale on dorsum, sides black; vulvar lamina as shown in Fig. 20, No. 10.

Measurements: total length, male 47, female 50-54 mm.; length of abdomen, male 34-35, female 36-38 mm.; length of hind wings, male 27-28, female 30-31 mm.; width of hind wings, male and female 9-9.5 mm.

Female described from specimens in the collection of P. P. Calvert, Philadelphia. One female taken by Mr. Bromley at Webster Lake, Mass., near the Connecticut line.

New England.—May 29-July 8.

Gomphus pallidus Rambur

Histoire naturelle des insectes. Neuroptères, 163: 1842.

Nymph.—Labium shown in Pl. v, Fig. 6.

Adult, male.—Color olive with pale brown markings.

Head: face including labium, clypeus and front, pale; occiput pale.

Thorax: meso- and metathorax pale (Fig. 22, No. 13), the mesepisterna with two narrow brown stripes on each, and a dark spot on mesopleural suture, caudad of the katepisterna; femora pale beneath, tibiae pale above.

Abdomen: brown with a yellow dorsal band on terga 1-7; anal appendages viewed from above with lateral and mesal margins of superiors entire; the tips sharply pointed; viewed from the side, the superiors show a knob-like ventral tooth, beyond the middle; accessory appendages as in Fig. 21, No. 13.

Female.—Vulvar lamina (Fig. 20, No. 12) a little less than one-fourth the length of segment 9, the plates in contact at apex, the median notch closed; occiput of the female variable, the ridge nearly straight in some, depressed at center in others. Some specimens apparently have no dark stripes.

Measurements: total length, male 55, female 60 mm.; length of abdomen, male 39, female 37 mm.; length of hind wings, male 32, female 33 mm.

The occurrence of this species in New England is doubtful, it being a southern form, found in Florida, Louisiana, etc. There is one record, however, from Massachusetts.

Gomphus villosipes Selys

Bulletin de l'Academie royale . . . de Belgique, 21: 53: 1854.

Nymph.—Labium with 6 teeth on the mesal margin of the palpi including the fixed end hook, which is not larger than any of the teeth. (Pl. v, Fig. 8.)

Abdomen: caudal segments lengthened and narrowed, with no lateral spines except on segment 9 (also on 8 according to Needham); a faint dorsal ridge on last segments. Tenth segment less than half as long as the ninth. Body clothed with a dense scurfy pubescence conspicuously marked (abdomen) with lines of bare scars.

Measurements: total length, 35-36 mm.; length of abdomen, 24 mm.; width, 8.5 mm.; hind femora, 5 mm.; dimensions of segment 9, 3 mm. long by 3.5 mm. wide at cephalic margin; segment 10, 1.75 mm. long by 1.5 mm. wide.

Adult, male.—Color brown and greenish.

Head: face pale; occiput with a spine or sharp tubercle at middle.

Thorax (Fig. 22, No. 15): median lobe of pronotum with three pale spots, and a median spot on caudal lobe; femora pale at bases beneath, the pale stripes tapering to the middle on middle and hind femora; meso- and metathorax mostly pale, the mesepisterna each with two narrow dark stripes, and a stripe on mesopleural suture.

Abdomen: dark, a pale spot on dorsum of tergum 1; short mesal stripes on 3-7 inclusive, reaching slightly beyond the middle

of each; sides of 1, 2, and 3 pale, the marks about 2 mm. in width; terga 8 and 9 largely dark brown, paler on the sides in some; segment 10 and anal appendages olive; margins of tergum 8 projecting ventrad, those of 9 nearly straight; accessory appendages as in Fig. 21, No. 8.

Female.—Vulvar lamina (Fig. 20, No. 11) about one-third as long as the ninth sternum; occiput with a conspicuous denticulate spine at middle.

Measurements: total length, male 52 mm., female 58 mm.; length of abdomen, male 37-39, female 38-41 mm.; length of hind wings, male 29-32, female 33-34 mm.; width of hind wings, male 8.5-9.5 mm.

Connecticut.—Described from specimens in collection of P. P. Calvert. A specimen collected in the vicinity of Storrs, Conn., but without place or date, has been examined: Hamden, 6 June, 1927 (P. G.).

New England.—June 6-June 30.

Group 4 SCUDDERI-AMNICOLA Group *Gomphus amnicola* Walsh

Proceedings of the Academy of Natural Sciences of Philadelphia, 396: 1862.

Adult, male.—Color yellow and dark brown to black.

Head: fronto-clypeal stripe dark, anteclypeus pale or smoky; ventral margin of labrum black.

Thorax: pronotum with pale spots on median and caudal lobes, those on the different lobes in contact; lateral pale spots apparently wanting; mesepisterna dark, each with a short isolated pale stripe near the dorsal carina, the two converging caudad; a pale streak over the mesopleural suture; dorsal third of cephalic shoulders of the mesepimera dark, and the interpleural suture also lined with dark; remainder of thorax pale (Fig. 22, No. 4); legs with dark femora, the hind femora with basal half yellow, and the caudal surfaces of front and middle femora also pale.

Abdomen: black with bright yellow as follows: dorsum of tergum, dorso-mesal stripe on 2, narrow stripe on 3, basal spots on 4-7, the latter showing a tendency to form stripes in some specimens; tergum 7 with a narrow elongate lateral spot sometimes remote from the margin, 8 and 9 with broad yellow lateral spots in contact with the margin only at the cephalo-lateral angles; tergum 8 with a bright basal spot on meson; accessory appendages characteristic (Fig. 21, No. 2); anal appendages black.

Female.—Abdominal segments with more yellow on sides; vulvar lamina one-fourth or one-fifth as long as sternum 9.

Measurements: total length, male 47, female 47 mm.; length of abdomen, male 35, female 35-36 mm.; length of hind wings, male 29-31, female 33 mm.; width of hind wings, male 9.5 mm.

Described from specimens in collection of Dr. P. P. Calvert.

Collected in Massachusetts by Bromley. Specimens in the Museum of Comparative Zoology also examined.

Gomphus notatus Rambur

Histoire naturelles des insectes. Neuroptères, 162: 1842.

Nymph.—Labium shown in Pl. v, Fig. 12. Lateral spines on abdominal segments 6 to 9 inclusive.

Measurements; young nymph in the Museum of Comparative Zoology: total length, 23 mm.; abdomen, 15 mm. Hind femora, 3 mm.; segment 9, 2 by 2.5 mm.

Adult, male.—Greenish yellow and black.

Head: face, pale black as follows: nearly all of labrum except a spot on each side; anteclypeus; a broad stripe on front, clypeal suture (nearly 1 mm. wide); occiput pale, and most of postgenae.

Thorax: pronotum with two very small spots on median lobe; meso- and metathorax mostly pale; mesepisterna dark with two nearly equal pale stripes; interpleural and metapleural sutures lined with dark (Fig. 22, No. 2); legs uniform dark brown; wings clear.

Abdomen: dark, with pale dorsal stripe on 1 and 2, and spot at base of 3; spot on cephalo-lateral angles of 3 and a broad lateral spot on 2; terga 4-7 inclusive, black; 8 with broad lateral pale stripe and small dorso-basal triangular spot; tergum 9 with pale margins but no basal spot on dorsum; segment 10 dark, a trifle paler on the margins; anal appendages dark brown to black; accessory appendages of the second segment characteristic of the species (Fig. 21, No. 1).

Female.—With more pale color than the male.

Head: labrum mostly pale, the spots occupying most of it; femora pale at base and below; abdomen with terga 1 and 2 broadly pale on sides, 3-5 inclusive with narrowly pale margins which extend dorsad a distance of 1-2 mm. at base, and each with an elongate spot a short distance above the margins; terga 6-7 obscurely marked with pale color on margins; 8 and 9 with pale margins, the pale color 1 mm. wide; segment 10 dark above, pale below; terga 3-8 with very small basal spots on dorso-meson.

Measurements: total length, male 32, female 55 mm.; length of abdomen, male 37, female 42 mm.; length of hind wings, male 30, female 35 mm.; width of hind wings, male 8.5, female 9.5 mm.

Described from specimens in collection of Dr. P. P. Calvert.

Gomphus scudderi Selys

Bulletin de l'Academie royale . . . de Belgique (2), 35: 752: 1873.

Nymph.—Head: front margin of the mentum nearly straight, with a sparse fringe of flattened scale-like hairs; palpi with hook of proximal segment incurved strongly, about at a right angle

beyond the distal segment or movable hook; about four teeth on the inner margin (Pl. v, Fig. 17).

Abdomen: elongate, tapering for half its length; a double row of trapezoidal blackish spots between mid-dorsal line and the line of scars on each side, each spot with a prolonged apical angle reaching the apical carina on each segment, the spots on 9 and 10 becoming diffused over the sides of the segments; a series of minute, longitudinal, yellowish dashes in the apical suture of each segment; mid-dorsal impressed line present and no dorsal hooks save a mere rudiment on apex of ninth segment; lateral spines well developed on segments 6-9, and tufts of hairs on lateral apical angles of preceding segments, the spines increasing slightly in size posteriorly, those of the ninth closely oppressed and hardly surpassing the base of the tenth segment.

Measurements: total length, 42 mm.; length of abdomen, 28 mm.; width of abdomen, 8 mm.; length of hind femur, 5.2 mm.

Description from Needham 1901; p. 457.

Adult, male.—Color yellow and black.

Head: face black as follows: a spot on the fronto-clypeal suture narrowed at middle; anteclypeus, ventral margin of labrum.

Thorax: anterior femora pale beneath; spines of hind femora arranged in two ventral rows; pronotum mostly black or dark brown; meso- and metathorax marked as in Fig. 22, No. 9, mostly dark, with a short pale stripe on each mesepisternum, and a pale streak above the mesopleural suture; mesepimera with a short pale stripe below the mesopleural suture; wings clear, stigma 4.5-7 mm. long in the front wing.

Abdomen: terga black marked with pale, basal rings on 3-7, a mid-dorsal stripe on tergum 2, a little more than half its length; terga 8 and 9 with a triangular spot on mid-dorsum and spots occupying the cephalo-mesal angles; 10 black except the cephalic margin; anal appendages black; auricles and sides of terga 1 and 2 pale.

Female.—Vulvar lamina as shown in Fig. 20, No. 17.

Measurements: total length, male 57-58, female 60 mm.; length of abdomen, male 40, female 44 mm.; length of hind wings, male 37-39, female 38 mm.; width of hind wings, male 9, female 9-11 mm.

Connecticut.—Cornwall, 11 September, 1925, meadow brook (L. B. W.).

Group 5 CRASSUS-FRATERNUS Group

Gomphus crassus Hagen

Bulletin de l'Academie royale . . . de Belgique (2), 46: 453: 1878.

Adult, male.—Color olive and dark brown to black.

Head: face including labium, labrum, clypeus and front pale; ocellar area black; occiput pale; postgenae black, pale at sides.

Thorax: pronotum with three obscure pale spots; meso- and

metathorax pale, with a broad brown stripe including the mesopleural suture, and a narrow pale stripe above the suture; mesepimeral shoulders dark, and metapleural suture lined with dark; legs black, coxae pale, the front femora greenish beneath, wings clear.

Abdomen: black or dark brown terga with a mid-dorsal streak wider on 1 and 2 and reduced to basal triangles on 7 and 8; 9 with a broad mid-dorsal band of yellow sometimes reduced to a small basal spot; 10 with a small spot or none; sides of terga 1 and 2 and base of 3 yellow, a conspicuous yellow spot on cephalolateral angles of 8, and broad yellow spot occupying the entire lateral margin of 9; anal appendages as in Fig. 23, Nos. 13, 15; accessories as in Fig. 21, No. 17.

Female.—No yellow dorsal spot present on the base of segment 9, the lateral spot on this as long as the segment; lateral margins of all abdominal terga broadly marked with yellow; vulvar lamina (Fig. 20, No. 18) about one-third as long as segment 9, the two plates together about as long as broad, tips separated.

Measurements: total length, male 46, female 46 mm.; length of abdomen, male 32, female 32-36 mm.; length of hind wings, male 28, female 27 mm.; width of hind wings, male 9, female 8.5 mm.

Described from specimens in collection of P. P. Calvert, Philadelphia. Specimens also examined in the Cambridge Museum of Comparative Zoology.

Gomphus fraternus (Say)

Journal of the Academy of Natural Sciences of Philadelphia, 8: 16: 1839.

Nymph.—According to Needham, the nymph of this species has strong tibial burrowing hooks, which are as long as the tibiae are wide; third segment of antennae twice as long as the first and second together. Mentum of labium squarish, in front of the contracted basal or proximal fourth; distal margin densely fringed, slightly convex; palpi bluntly angular with 7-11 small teeth on the inner margins.

Abdomen: with sides parallel most of its length, abruptly narrowed beyond the sixth segment, and with minute dorsal hooks on segments 8 and 9; median groove present in anterior segments; well-developed lateral spines on segments 6-9, those of 9 about equaling the appendages.

Measurements: length, 31 mm.; length of abdomen, 20, width, 9 mm.; length of hind femur, 6.5 mm.

Description from Needham, 1901: p. 451.

Adult, male.—Color yellow and black or dark brown.

Head: face pale including labrum, clypeus and front, except a dorsal transverse line in front of ocelli, which is black; ocellar area black, occiput pale; postgenae black, pale at sides.

Thorax: pronotum with yellow spots and caudal margin, meso- and metathorax dark brown and yellow, pattern as in Fig. 22, No. 8.

Abdomen: brown with pale dorsal lines on terga 3-6, and broader ones on 1 and 2 (1.5 mm. broad); sides of 1 and 2 and part of 3, pale; basal spots on 7 and 8 (sometimes 9), a large spot on the cephalo-lateral angles of 8, and larger spots occupying the entire ventral margin of 9; segment 10 and anal appendages black; segments 8 and 9 much expanded, the distance between the ventral margins of terga 8 measuring about 4 mm.

Female.—Similar to the male, but with pale stripes on the lateral or cephalic surfaces of the hind femora; terga 7 with a pale spot on lateral margin; lateral margins of 3-5, and broad lateral stripes on 1-3 also pale; vulvar lamina as in Fig. 20, No. 14.

Measurements: total length, male 50, female 55 mm.; length of abdomen, male 35-39, female 38-40 mm.; length of hind wings, male 29-30, female 31-32 mm.; width of hind wings, male 9, female 10 mm.

Described from specimens in collection of P. P. Calvert and a male and female in the collection of the writer.

Gomphus graslinellus Walsh

Proceedings of the Academy of Natural Sciences of Philadelphia, 394: 1862.

Nymph.—Labium shown in Pl. v, Fig. 1.

Adult, male.—Color olive and dark brown to black.

Head: labium, labrum, clypeus and front except a black transverse preocellar stripe, pale; occiput pale; postgenae brown, pale at sides.

Thorax: pronotum with 3 yellow spots; mesothorax with a broad median pale stripe on each mesepisternum which connects with the mesothoracic half-collar in front and with the narrow pale lateral streak (sometimes very indistinct) at the wing bases; metepimera with a broad pale stripe from shoulder to wing base, most of the metepisterna brown, the metepimera pale, with dark cephalo-dorsal border; venter of thorax pale; legs mostly black, the coxae and trochanters pale, femora black (sometimes with pale cephalic surfaces); tibiae black with a faint streak at base, tarsi and claws black; wings clear.

Abdomen: with yellow mid-dorsal stripe on terga 1-6 inclusive, and basal spots in line on 7 and 8; 9 with a broad mid-dorsal stripe, 10 with a narrow line; sides of terga 1 and 2, basal portion of 3, small circular spots on cephalo-lateral angles of 4-7 inclusive, yellow; broad yellow stripes on lateral margins of 8 and 9; anal appendages black; superiors viewed from above with a prominent lateral angle, the angle also visible from the side. Accessory appendages as shown in Fig. 22, No. 7.

Female.—Femora marked with pale on the sides (cephalic surfaces); abdomen with broad lateral stripes on margin of terga 1-5, obscurely so on 6-7, more distinct on 8 and 9; segment 10 entirely black; vulvar lamina consisting (Fig. 20, No. 6) of two short rounded lobes about one-sixth as long as segment 9.

Measurements: total length, male 47-50, female 47-50 mm.; length of abdomen, male 33-36, female 33-36 mm.; length of hind wings, male 30, female 30-31 mm.; width of hind wings, male 8.5-9.5, female 9 mm.; length of stigma, 3-4 mm.

Described from material in the collection of P. P. Calvert.

***Gomphus vastus* Walsh**

Proceedings of the Academy of Natural Sciences of Philadelphia, 39: 1862.

Nymph.—Labium with five to six teeth on the mesal margins of the labial palpi; terminal fixed hook bent at right angles (Pl. v, Fig. 13).

Abdomen with lateral spines on segments 6 to 9 inclusive, those on 9 as long as segment 10; dorsal projections on segments 8 and 9.

Measurements: Total length, full-grown, 32 mm.; length of abdomen, 20 mm.; hind femora, 5 mm.; dimensions of segment 9, 9.2 mm. long by 4 mm. wide at cephalic margin.

Adult, male.—Black and yellow.

Head: pale, black as follows: a broad stripe on the fronto-clypeal suture, anteclypeus, ventral and dorsal margin of the labrum, median spot on the labrum, most of the postgenae; occiput pale.

Thorax: pronotum with 3 pale spots of similar size; meso- and metathorax as in Fig. 22, No. 7, the dorsal pale stripe of the mesepisterna narrow, connected with the collar in front and sometimes connected at the wing bases with the narrow lateral stripe; mesepimeral shoulders black, the interpleural fold also lined with black or dark pigment; front femora pale beneath, wings clear.

Abdomen: a dorsal pale line on terga 3-6 inclusive and sometimes a basal streak on 7, and broader bands on 1 and 2, sides of 1 and 2, and basal half of 3, pale; a pale spot on cephalo-lateral angles of 8, but a sub-triangular yellow spot on sides of terga 9; terga 7-9 dilated; anal appendages slender, the superiors without conspicuous ventral teeth.

Female.—Middle femora pale beneath; vulvar lamina as in Fig. 20, No. 19, more than half as long as segment 9, narrowed at apex, the tips of the plates in contact.

Measurements: total length, male 51, female 55-56 mm.; length of abdomen, male 40, female 37 mm.; length of hind wings, male 30, female 32 mm.; width of hind wings, male and female 9 mm.

Described from specimens in the collection of P. P. Calvert, Philadelphia.

Gomphus ventricosus Walsh

Proceedings of the Entomological Society of Philadelphia, 2: 249: 1863.

Adult, male.—Color olive and black.

Head: face yellow except the lateral margins of the labrum and a preocellar stripe on the front; ocellar area black; occiput pale; postgenae black, pale at sides.

Thorax (Fig. 22, No. 3): with broad (1 mm.) parallel yellow stripes on the mesepisterna, and a pale streak above the suture; about half the length of the sclerite; mesepimeral shoulders black; legs black, coxae but little paler; wings clear.

Abdomen: with pale mid-dorsal stripe on 1-6 or 7, the stripe trilobed on segment 2, expanded at apex of 1; sides of 1 and 2 and base of 3 pale, and pale yellow spots on sides of 8 and 9 which are remote from the margins; a faint touch of yellow on side of 7; ventral margins of 8 considerably rounded, the distance between the two measuring 5-6 mm. when fully expanded; anal appendages with slender superior (lateral profile), the tips spine-like; accessory appendages similar to *crassus*, Fig. 21, No. 17.

Female.—Vulvar lamina similar to *vastus*, the pointed tips more divaricate (Fig. 20, No. 16).

Measurements: total length, male 50, female 47 mm.; length of abdomen, male 33-35, female 34-35 mm.; length of hind wings, male 28, female 30 mm.; width of hind wings, male 9, female 10 mm.

Connecticut.—Salisbury, 13 June, 1926 (P. G.).

Group 6 PLAGIATUS-SPINICEPS Group

Gomphus plagiatus Selys

Bulletin de l'Academie royale . . . de Belgique, 21: 57: 1854.

Nymph.—Labium shown in Pl. v, Fig. 3.

Adult, male and female.—A very large species occurring in New Jersey, Pennsylvania and southwards, which may be distinguished from nearly all species of *Gomphus* by the brownish red color of the abdomen, being almost entirely so in teneral specimens. The species has not been captured in Connecticut.

Measurements: total length, 60-63 mm.; length of abdomen, 43-47 mm.; length of hind wings, male 32-36, female 37 mm.; width of hind wing, male 9.5 mm.

Specimens examined in the collection of William T. Davis, from Long Island, New Jersey, Washington, D. C., and Florida.

Gomphus spiniceps Walsh

Proceedings of the Academy of Natural Sciences of Philadelphia, 389: 1862.

Nymph.—Terminal abdominal segments greatly narrowed and lengthened, about twice as long as wide; lateral spines present on

segments 6 to 9, no dorsal prominences except on segment 9. Labium as in Pl. v, Fig. 14.

Measurements: total length, 36 mm.; length of abdomen, 25 mm.; length of hind femora, 4 mm.; dimensions of segment 9, 5 mm. long by 2 mm. wide.

Adult, male.—Color black and yellow.

Head: face black with the dorsum of the front pale.

Thorax: mesepisterna with the pale stripe .75 mm. wide, not connected with the pale collar, and with considerable interval between the caudal end and the dorsal carina; a pale streak over the mesopleural suture; metepimera with pale stripe 1 mm. wide by 5.5 mm. long; metepisterna with a pale streak, the dorso-cephalic margin of the metepimera dark, remainder pale.

Abdomen: black with small mid-dorsal pale spots at base of segments 3-7 inclusive; lateral margins of 8 and 9 pale; anal appendages black, the superiors without spines in lateral or dorsal view; accessories with long tapering hamules, vesicle prominent.

Female.—Vulvar lamina very short, about three times as broad as long.

Measurements: length of abdomen, male 46, female 47 mm.; length of hind wings, male 37, female 39 mm.; length of abdominal segments 8, 9 and 10, 4, 5.5 and 1 mm.

According to Williamson this species flies from July to September.

Genus *Dromogomphus* Selys

Nymphs.—Proximal segment of labium hooked; third antennal segment, long, cylindrical; fourth segment small, its length less than the width of the third segment; middle coxae not more closely approximate than the front; dorsal projections on abdomen, segments 2-9; and segment 9 with mid-dorsal ridge ending in a sharp spine.

Adults.—Wings without subcostal vein; triangles without cross-veins; anal loop in hind wings consisting of two cells; occiput with a distinct ridge between compound eyes. Hind femora with long spines interspersed with shorter ones, and reaching the caudal margin of the second abdominal segment.

Key to Species

Adults

Males and Females

1. Hind femora entirely black; dorsal pale stripe of mesepisternum not reaching the katepisternum; segments 8, 9, and 10 mostly black, the cephalic half of segment 3-6 not pale in the male, with black transverse interrupted dashes **spinosus**
Hind femora in part yellow; pale stripes of the mesepisternum reaching the katepisternum; segments 8, 9 and 10 almost entirely pale, the basal half of segments 3-6 in the male pale with black transverse dashes interrupted on the meson **spoliatus**

Dromogomphus spinosus Selys

Bulletin de l'Academie royale . . . de Belgique, 21: 59: 1854.

Nymph (Pl. III, Fig. 6).—Head: labium extending caudad between the front coxae; distal margin of the median lobe slightly concave (Pl. v, Fig. 9), the labial palpi with 6 to 7 teeth on the mesal margins; antennae with the third segment cylindrical or only slightly flattened, the fourth minute, almost indistinguishable.

Thorax: wing-cases reaching the fourth abdominal segment, the hind femora reaching about to the middle of that segment.

Abdomen: a sharp distinct ridge on the dorsum of segment 9, sharp projecting dorsal hooks on segment 6-9 inclusive and tubercular dorsal prominences on segments 2-5, lateral spines on segments 6-9 inclusive, that on 9 about half the length of segment 10.

Measurements: total length (exuviae), 32-33 mm.; length of abdomen, 22 mm.; length of hind femora, 5-6 mm.; dimensions of segment 9, 2.8-3 mm. long by 4 mm. wide at base.

Adult, male.—Color dark brown and yellow.

Head: labium and face below the antennae yellow, dark immediately in front of the antennae; ocellar area dark; curved ridge behind the ocelli, without a conspicuous spine at each end; occipital ridge depressed at center, the ridge with long black setae; occiput black; postgenae black above, pale below.

Thorax: pronotum black with cephalic and caudal margins yellow, and a yellow spot on the meson in contact with the caudal division; dorsal carina and mesothoracic half-collar yellow, dorsal stripes of the mesepisterna not connected with the collar and rather closely approximated to the carina, also slightly diverging cephalad; a faint line above the mesopleural suture; ventral half of the mesokatepisterna yellow; metapleura and venter of the thorax yellow. Ventro-caudal surface of the front femora yellow, remaining femora and all tibiae and tarsi black; hind femora with five to six long spines, in one row beneath, and another row of spines approximately one-third this length also on the venter.

Abdomen: black or dark brown and yellow, the dorsal longitudinal stripe extending from terga 1 to 8 inclusive, trilobed on tergum 2; broad lateral stripes on terga 1 to 3 or 4, very distinct, more or less confused with brown on 5 to 9; terga 10 dark brown, obscurely pale above; superior anal appendages entire, not toothed, the inferior about as long as the superiors, broadly bifurcate, the arms upcurved at tips.

Female.—Color as in the male though usually brighter.

Head: ocellar ridge with a sharp spine at either end; occiput yellow.

Abdomen: vulvar lamina acute at tips, the lateral margins plainly concave, median notch apparently extending to the bases of the plates, the plates in contact for half this length.

Measurements: total length, male 55, female 57 mm.; length

of abdomen, male 40, female 41-42 mm.; length of hind wings, male 34, female 35-36 mm.; width of hind wings, male and female 10-11 mm.; length of stigma, male 4, female 4-4.5 mm.

Connecticut.—Guilford (Pistapaug Pond), 8 July, 1921 (P. G.); Windsor, 20 June, 1926 (P. G.; J. L. R.); West Hartford, 15 July, 1913 (L. B. W.).

New England.—June 12-September 1.

***Dromogomphus spoliatus* Selys**

Bulletin Academie royale . . . de Belgique, 21: 59: 1854.

Adult, male.—Head: with pale face.

Thorax: pale streak each side on femora, the hind femora with 6 long spines with about 5 smaller ones between, and with numerous shorter ones at base; two pale stripes nearly equal on each mesepisternum; narrow dark stripe on each of the two lateral sutures.

Abdomen: tergum 1 pale on sides and with a pale dorsal line; 2 with pale sides and dorsal streak; 3 with pale sides and dorsal streak, the dorsal streak connected at middle with pale sides; 4 to 6 with basal fourth pale, also with pale dorsal streak; 7 to 10 general color brown, their margins pale; dorsal anal appendages viewed from the side, simple, pale, darker below and sharply pointed; ventral appendage broad, upturned at tip when viewed from the side, in ventral view the arms divaricate, suddenly constricted at tips; tips blunt.

Female.—Vulvar lamina similar to those of *Gomphus descriptus* (Fig. 20, No. 13) but the plates more slender at tips.

Measurements: total length, male 60, female 64 mm.; length of abdomen, male 43, female 46 mm.; length of hind wings, male 36, female 37 mm.; width of hind wings, male and female, 11 mm.

Specimens examined in the U. S. National Museum.

Family AESHNIDAE Rambur

Nymphs.—Usually elongate insects; labium flat with a closed median cleft; tarsi three-segmented; antennae composed of cylindrical segments about equal in diameter and length; abdomen never broad and flat.

Adults.—Compound eyes contiguous; tibial spines simple; wings with an oblique cross-vein behind the proximal end of the stigma; female always with a well-developed ovipositor.

A large group of strong fliers, being exceptionally quick on the wing and hard to capture when fully mature.

Key to Genera

Nymphs

1. Dorsal hooks on abdominal segments 7 to 9 **Nasiaeschna**, p. 193
- No dorsal hooks on abdominal segments 7-9 2

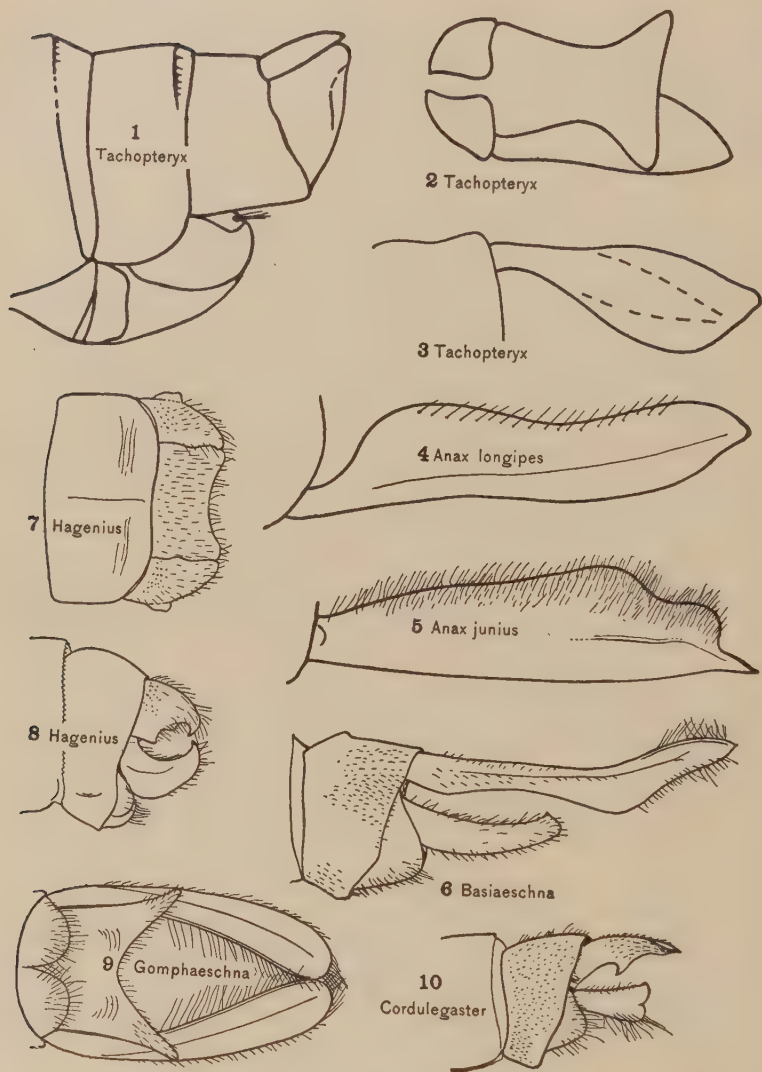


FIG. 24. Appendages of six genera of Anisoptera. 1. *Tachopteryx thoreyi*, female ovipositor. 2. Same, inferior appendage from below. 3. Same, left superior appendage from above. 4. *Anax longipes*, right superior appendage from above. 5. *Anax junius*, right superior appendage from above. 7 and 8. *Hagenius brevistylus*, anal appendages from above and in lateral profile. 9. *Gomphaeschna furcillata*, anal appendages from below. 10. *Cordulegaster maculatus*, anal appendages in profile.

2. Palpi with large teeth on mesal margins (Pl. VI, Fig. 2); a dorsal ridge present on abdominal segments 7, 8, and 9; antennae 6-segmented **Epiaeschna**, p. 195
 Palpi without large teeth on the mesal margins; no dorsal ridge on segments 7, 8 and 9; antennae 7-segmented 3
3. Caudo-lateral margins of the head distinctly angulate or, if obtusely angulate or rounded, then the lateral terminal appendages only one-fourth the length of the inferiors 4
 Caudo-lateral margins of the head rounded, or if obtusely angulate, then the lateral anal appendages more than one-fourth the length of the inferiors 5
4. Proximal segment of the labial palpi squarely truncate at the apices; lateral anal appendages about one-fourth the length of the inferiors; distal margin of the mentum with a small pointed tooth on each side of the median cleft (Pl. VI, Fig. 8; Fig. 7, Nos. 6, 7) **Boyeria**, p. 172
 Proximal segment of the labial palpi not squarely truncate at the apices; lateral anal appendages more than one-fourth the length of the inferiors; distal margin of the mentum without a pointed tooth on each side of the median cleft (tooth rounded if present) **Basiaeschna**, p. 174
5. Surface of cuticle of abdomen smooth, shining; lateral marginal spines on abdominal segments 7 to 9; basal segment of male superior appendage truncate at apex **Anax**, p. 177
 Surface of the cuticle not smooth, usually dull; lateral marginal spines on abdominal terga 5 or 7 to 9, usually 6 to 9; basal segment of the superior appendage bluntly pointed at tip **Aeshna**, p. 179

Adults

1. Thorax uniform green; M_2 (Pl. IX, Fig. 2) making a bend towards M_1 at the distal end of the stigma; anal angle of wings similar in the two sexes; abdomen with 2 lateral ridges on each side of terga 4-8 **Anax**, p. 177
 Thorax with more or less brown or black; M_2 not bending towards M_1 at the distal end of the stigma; anal angle of the wings dissimilar in the two sexes; abdomen with a single lateral ridge on each side of terga 4-8 2
2. Basilar space with more than one cross-vein (Pl. VIII, Fig. 1) .. **Boyeria**, p. 172
 Basilar space without or with a single cross-vein 3
3. R_s forked 4
 R_s not forked 6
4. Length of abdomen over 55 mm.; hind wings 55 mm. (Fig. 39) .. **Epiaeschna**, p. 195
 Length of abdomen usually less than 55 mm.; hind wings not over 50 mm. in length 5
5. Cephalic section of arculus longer than the caudal; only one row of cells between R_s and the R supplement (Pl. VIII, Fig. 3) **Nasiaeschna**, p. 193
 Cephalic section of the arculus shorter than the caudal section; more than one row of cells between R_s and the R supplement (Pl. IX, Fig. 1) **Aeshna**, p. 179
6. Supertriangular area free from cross-veins (Pl. XII, Fig. 3) ... **Gomphaeschna**, p. 176
 Supertriangular area with cross-veins (Pl. VIII, Fig. 4) **Basiaeschna**, p. 174

Genus *Boyeria* McLachlan

Nymphs.—Caudo-lateral margin of the head angulate; proximal segment of labial palpus truncate at apex; mental cleft closed; abdomen with lateral spines on segments 5-9, but no dorsal hooks on any of them.

Adults.—Upper section of arculus as long as the lower; M_2 not making a sharp bend towards M_1 at end of stigma; R_s not forked and 1 to 2 rows of cells between it and the supplementary radius; triangle, supertriangle and basilar space with cross-veins; cells of anal loop numerous (9 or more) in several rows; cubito-anal cross-veins about 5-6 in number; anal angle of the hind wings dissimilar in the two sexes, the anal triangle of the male usually with 5 cells; thorax brown, green and yellow; abdomen with a single lateral keel per segment on each side; inferior anal appendages of the male entire.

The nymphs of our one representative have been found most frequently in meadow brooks or woodland creeks among roots or driftwood.

Key to Species

Adults

Males and Females

1. Pale spots on sides of the thorax and abdomen sometimes blue in color; superior anal appendage of the female about as long as segment 10 (1.5 mm.); tips of the wings brown, the remainder clear **grafiana**
- Pale spots on the sides of the thorax and abdomen yellow; superior anal appendages of the female much longer than segment 10 (3.5 mm.); entire wing brown **vinosa**

Boyeria grafiana Williamson

Entomological News, 18: 1: 1907.

This species has been captured in Massachusetts and Pennsylvania, and there is a possibility that it may be found in Connecticut. The adults are fairly well distinguished by the characters in the key.

Boyeria vinosa (Say)

Journal of the Academy of Natural Sciences of Philadelphia, 8: 13: 1839.

Nymph (Pl. III, Fig. 4).—Color dark brown.

Head: mentum extending between the middle coxae; cephalic margin with a closed cleft, a fringe of hairs and a tooth on each side of the cleft; proximal segment of the palpus squarely truncate (Fig. 7, No. 6), with a denticulate mesal edge; antennae with the first two and last segments darker in color than the rest; compound eyes, with dorso-mesal extension rounded and separated from each other by approximately 1.5 mm. on the meson; caudo-lateral margins of the head sharply angulate.

Thorax: pronotum with the lateral margins flaring considerably, and rounded; two long heavy spines above the procoxae; legs mostly brown, the femora and tibiae each with two narrow pale rings; third tarsal segment pale at base; wing-cases extending to the middle of abdominal segment 2 (young nymph).

Abdomen: flat below, without dorsal spines, but with lateral spines on segments 5-9, those on 9 more than half as long as segment 10; anal appendages brown with pale tips, extreme tip, however, brown; the superior appendage bifid at tip and nearly as long as the ventral appendages; lateral appendages one-fourth as long as the ventral; a small but conspicuous pale mesal spot on the dorsum of tergum 8.

Measurements: total length (immature nymphs), 25 mm.; length of abdomen, 15 mm.; hind femora, 4 mm.; length of metathoracic wing-cases, 3 mm.

Described from nymphs obtained in a small stream at Orange, Conn., by the writer. The superior anal appendage is said to be entire in some specimens.

Adult, male.—Color dark brown, marked with green and yellow.

Head: labium, labrum, clypeus and front yellow or buff; rear of head and vertex yellow; line of contact of the eyes 2 mm. in length.

Thorax: robust with a dorsal green stripe on each side that is more or less obscure in dried specimens, the mes- and metepimera each with a bright yellow spot about 1 mm. in diameter, slightly cephalad of the middle of the sclerite; legs entirely brown; second segment of trochanters with a polished area and one or two short spines beneath; femora with two ventral carinae thickly studded with short subequal spines; middle tibia sometimes with a few scales at tip; distal segment of tarsi as long or longer than the two proximal ones together; tarsal claws with ventral tooth placed at or slightly beyond the middle; wings (Pl. VIII, Fig. 1) flavescent throughout, darker at extreme base; hind wings with an anal triangle composed of 5 cells. Antenodal cross-veins 23-24 in the front wing and 16-17 in the hind wing; basilar space with 4-6 cross-veins, supertriangular space with 3-5; the triangle with 5-6 cells; R_s without a distinct fork, the supplementary radius distinct to the margin of the wing; supplementary media also very distinct and traceable to the margin.

Abdomen: uniform brown; third segment greatly narrowed; conspicuous transverse furrows on terga 2-8; terga 3-8 with distinct dorsal and lateral carinae; auricles of segment 2 flaring considerably and with numerous (more than 20) small teeth on the ventral margins; genital lobes of second segment with small teeth on the ventral margin, and a lateral depression on each; superior anal appendages with a ventral tooth at base, and a dorsal carina; apices blunt, the appendages widest considerably beyond the middle; superior anal appendages 4.5 mm. long, by .8 mm. wide,

bluntly pointed, rather sparsely setose with long black setae mesad of the dorsal carina; a short ventral tooth present within one mm. of the base; inferior appendage triangular, 1.5 mm. long by 1 mm. wide at base, the tip blunt and with two rounded recurved projections.

Female.—Similar to the male in color; anal appendage 3.5 mm. long, bluntly pointed and flat; widest beyond the middle; ovipositor extending beyond the caudal margin of the ninth segment, the narrow lateral plates more than half the length of that segment; lateral valves each with a feeble lateral keel, and not pointed at the base of the styli; styli .75 mm. long, much shorter than the dorsum of segment 10.

Measurements: total length, male 60-63, female 62-65 mm.; length of abdomen, male 45, female 47 mm.; length of hind wings, male 41-42, female 45 mm.; width of hind wing, male 12, female 14 mm.

Connecticut.—Kent, 31 August, 1904 (W. E. B.); North Branford, 18 September, 1915 (G. A. F.); Litchfield, 15 May, 1915, 6 June, 1925 (L. B. W.).

New England.—May 15-September 26.

Genus *Basiaeschna* Selys

Nymphs.—Caudo-lateral margins of the head angulate; labial palpi not truncate at apex; abdomen with lateral spines on segments 3 or 4-9; hooks present on dorsum of abdomen.

Adults.—Wings with upper section of arculus as long as the lower; M_2 not making a sharp bend at distal end of stigma; R_s not forked, and 1 to 3 rows of cells between it and the supplementary sector; triangle and supertriangle with cross-veins; basilar space free or with a single cross-vein; anal loop of about 6 cells; cubito-anal cross-veins 3 to 4; anal angle of hind wings dissimilar in the two sexes, the anal triangle of the male with 2 cells; thorax not uniform green; abdomen with a single lateral carina per segment on each side; inferior anal appendages of male entire.

The nymphs of this genus are very common about New Haven and may be found either in small streams or woodland ponds. They are apparently much more common than the adults and it is possible that they may have some of the same habits of dispersal as are found in the Gomphidae. The nymphs are climbers like other Aeshnidae. Needham (1901, p. 466) has described the process of oviposition, and he states that the eggs are deposited in neat double rows in the submerged leaves of bur-reed and *Sparganium*.

Basiaeschna janata Say

Journal of the Academy of Natural Sciences of Philadelphia, 13: 1839.

Nymph (Pl. III, Fig. 3; Fig. 1).—Color light and dark brown. Head: labium (Pl. VI, Figs. 1 and 7) extending between the

middle coxae; median lobe with a closed median notch and hairy distal margin; palpi with a sharp fixed hook (not truncate as in *Boyeria*); antennal segments subequal in length, the first two and distal half of 7 darker than the rest; compound eyes black, the mesal angles separated by 1 mm.; surface of the head behind the eyes rugose, with two nearly circular glabrous spots behind the mesal angles of the compound eyes and a smaller one on the mid-dorsum; caudo-lateral margins of the head angulate.

Thorax: pronotum with flaring and rounded lateral margins; the procoxa with two blunt projections dorsad of each on the pleura; meso- and metapleura, dark brown; legs conspicuously banded, mostly dark brown, both femora and tibiae with three light-colored rings; tarsi each with a double row of forked spines below, distal half or more of the second and third segments pale; wing-cases extending to the apex of abdominal segment 5, hind femora when extended parallel to the body, reaching the caudal margin of abdominal segment 5 in full-grown nymphs.

Abdomen: dark brown with a paler, somewhat indefinite band on mid-dorsum of 1-7, and a bilobed spot of the same color on 9 and 10; spines on lateral keels of segments 5-9 inclusive; ventral terminal appendages with a little more than the basal half brown, the tips also brown, remainder pale; superior appendage a little more than half as long as the ventrals, the laterals about two-thirds as long as the superior.

Measurements; mature nymph: total length, 29-32 mm.; length of abdomen, 17-19 mm.; greatest width, 7 mm.; length of hind femora, 5 mm.; length of median lobe of labium, 5-5.5 mm., width, 2.5-4 mm.

Immature Nymphs: total length, 24-26 mm.; length of abdomen, 10-13 mm.; greatest width, 5.5-6 mm.; length of hind femora, 4.5 mm.; length of median lobe of labium, 5 mm.; width, 2-3.5-4 mm.

Adult, male.—Color brown marked with yellow and green.

Head: brown, front yellowish, pilose above and with a T-spot; compound eyes contiguous for about 1 mm.; occiput and post-genae brown, pale on sides.

Thorax: mesothorax brown, with obscure greenish or grayish areas above, the mesepimera each with a yellow stripe measuring 4 mm. by less than 1 mm., the metepimera with a similar stripe, both surrounded by very dark brown or black; legs brown, tarsi almost black; femora with two rows of short sharp spines beneath, tibial spines a trifle longer than the intervals between; wings (Pl. VIII, Fig. 4) flavescent, extreme bases brown; front wings with 11 to 14 postnodal cross-veins.

Abdomen: brown in dried specimens, marked with green; blue in fresh; third segment narrowed at middle, lateral margins of tergum 2 extending ventrad, forming a thin plate on each side of the accessory appendages; anal appendages as in Fig. 24, No. 6,

the superiors considerably expanded at the distal third, the inferior about half as long as the superiors, both dark brown.

Female.—Color similar to the male; anal appendages linear, flat, 3.5 mm. long.

Measurements: total length, male 51-55, female 55-60 mm.; length of abdomen, male 35-43, female 38-43 mm.; length of hind wings, male 31-36, female 35-36 mm.; width of hind wings, male 9, female 9-10 mm.

Connecticut.—New London, 7-16 June, 1921 (R. H. H.); Orange, May 1922 (P. G.).

New England.—May 9-July 18.

Genus *Gomphaeschna* Selys

Adults.—Wings with upper half of arculus as long as the lower; M_2 not making a sharp bend towards M_1 at distal end of the stigma; R_s not forked; only one row of cells between R_s and the supplementary radius; triangle with cross-veins; supertriangle and basilar space free; anal loop consisting of 3-4 cells; cubito-anal cross-veins 2; anal angle of the hind wings dissimilar in the two sexes, the anal triangle consisting of 2 cells in the male; abdominal terga 4-7 with only one lateral longitudinal ridge per segment on each side; inferior appendages of the male bifurcate.

Nymphs of this genus have not been reared. The adults have been captured in various localities but they are such strong fliers that it is impossible to even guess at the probable habitat of the nymph.

Gomphaeschna furcillata (Say)

Journal of the Academy of Natural Sciences of Philadelphia, 8: 14: 1839.

Adult, male.—Color brown, marked with green or yellow.

Head: labium, labrum, clypeus and front dark brown, sometimes marked with yellow; T-spot of front with upright expanded; occiput and rear of head black.

Thorax: brown, mesepisterna each with two short yellow or green dashes and two small spots cephalad of the wing-bases; broad greenish stripes on mes- and metepimera, and several small triangles between the two; wings clear.

Abdomen: terga 1 and sometimes 2 obscurely pale on sides; dorsum of 2 with about 5 greenish or yellow spots; terga 4-7 with a bilobed spot on cephalo-lateral angles and 3 triangular dorsal pale spots (there are sometimes two small additional dots on the transverse carinae); tergum 8 with two pale triangles on dorsum; 9 and 10 obscurely pale on dorsum at apices; anal appendages (Fig. 24, No. 9) black or brown, the superiors about twice as long as the inferior, thin and rounded at tips; inferior appendage bifurcate, the arms slender and strongly divaricate, segment 10 with a mid-dorsal carina.

Female.—Wings (Pl. XII, Fig. 3) with a brownish patch near the stigma; anal appendages flat, the tips rounded and margins setose (length 1 mm.); venter of eighth sternum not covered by the terga, but projecting ventrad, with a conspicuous median carina which forks cephalad.

Measurements: total length, male 56, female 49-51 mm.; length of abdomen, male 38-44, female 38-40 mm.; length of hind wings, male 31-36, female 31-36 mm.; width of hind wings, male 8-9, female 9.5-10 mm.

Several specimens in the collection of the Connecticut Agricultural Experiment Station; a male in the Yale University collection. The variety *antelope* (Hagen) has a much slenderer abdomen, and the tips of the inferior appendage of the male are much less widely separated.

Connecticut.—Westville, 14 June, 1905 (W. E. B.), 2 June, 1908 (B. H. W.); North Branford, 9 June, 1912 (B. H. W.); New Haven, 28 July, 1914 (Q. S. L.); Lyme, 16 June, 1918 (M. P. Z.); New London, 6 June, 1921 (R. H. H.); Hamden, 8 June, 1922 (P. G.); Haddam, 20 June, 1926 (P. G.).

New England.—May 4-July 28.

Genus *Anax* Leach

Nymphs.—Hind angles of the head viewed from above obtusely rounded; labial palpi rounded at end to a distinct internal hook; abdomen with lateral spines on segments 7-9, but no dorsal hooks.

Adults.—Wings with upper half of arculus shorter than lower; M_2 making a sharp bend towards M_1 at distal end of stigma; R_s forked; several rows of cells between R_s and the supplementary sector; triangle and supertriangle with cross-veins; basilar space without cross-veins; anal loop with several rows of cells; cubito-anal cross-veins 3 or 5; anal angle of hind wings similar in the two sexes; thorax uniform green; abdomen with at least two lateral ridges on middle segments; inferior appendage of male entire.

Key to Species

Males and Females

1. Dorsal surface of front without a black spot; hind femora 14-16 mm. long **longipes**
- Dorsal surface of front with a black spot surrounded by a lighter area; hind femora not over 11 mm. long **junius**

The adults of the genus are very strong fliers, not easily captured. The species *longipes* is reported to occur only along the seacoast and has never, as far as I am aware, been taken very far inland. The nymphs inhabit small ponds and are climbers upon submerged vegetation like other Aeshnidae. The eggs are inserted into the stems of reeds or other plants beneath the surface of the water.

Anax junius (Drury)

Illustrations of Natural History—Exotic Insects 1: pl. 47, f. 5: 1773.

Nymph (Pl. III, Fig. 5).—Color green, or brown, the young nymph with a darker transverse band across the abdomen.

Head: labium (Pl. VI, Fig. 7) gradually contracted caudad and extending between the middle coxae or beyond; labial palpi with sharp proximal segment; dorsum of head flattened, antennae with the third segment longest, fourth shortest, the others subequal; sides of labrum and caudo-lateral surfaces of the head granular.

Thorax: pronotum without strongly projecting lateral angles, wing-cases extending to or nearly to the fifth abdominal segment in the full-grown nymph; venation of the adult clearly indicated in older nymphs which affords a means of separating it from the nymphs of *Aeshna*.

Abdomen: lateral spines on segments 7 to 9, the anal appendages about as long as the last two segments in mature specimens; segments 4 to 9 with a glabrous figure 8 scar shortly above the lateral keels; ovipositor of the female about two-thirds the length of segment 9; proximal segment of the dorsal anal appendage of the male bluntly excavated at tip.

Measurements; exuviae: total length, 50-64 mm.; length of abdomen, 29-35 mm.; hind femora, 11-12 mm.; median lobe of labium, 9.5-13 mm. long.

Adult, male.—Color green and brown.

Head: labium, labrum, clypeus and front, except the dorsal surface, yellowish green; the dorsal surface of the front with a black, egg-shaped, central spot surrounded by a pale yellow semicircle, and a black or brownish semicircle outside the yellow; median ocellus very large, above which is a transverse ridge with a lateral ocellus at either end; occiput and postgenae mostly pale, yellow but dark just below the dorsal margins of the compound eyes.

Thorax: prothorax brown, meso- and metathorax mostly pale green; sclerites divided by distinct lines or spurious sutures; the katapisterna and the areas surrounding the coxae brownish; legs brown to black; coxae, trochanters, and sometimes the femora brown; front femora yellowish below, and the trochanters with a small glabrous area on the ventral surface; tarsal claws with ventral tooth proximad of the middle; wings clear (Pl. IX, Fig. 2) with a decided brownish or yellowish tinge in most specimens; vein M_2 has a sharp bend at the distal end of the stigma, supplementary sectors present between R_s and M_3 and between M_4 and Cu_1 .

Abdomen: first two segments bulbous, the diameter of the following segments reduced to one-half or one-third that of the first two; segments 1 and 2 and part of 3 green or bluish, remainder of abdomen brown, blue on sides; terga 4-7 each with two longi-

tudinal ridges on either side, and a dorsal carina on 2-7; a transverse ridge on 2 which connects with the dorsal carina; anal appendages consisting of a short, broad, pale inferior with short tubercles on the apical margin and dorsal surface; superiors (Fig. 24, No. 5) about as long as segment 9 plus 10; they are nearly triangular in cross section, have a short tooth at the apex and a dense brush of hairs on the mesal surface near apex; accessory genitalia almost hidden by the projecting terga.

Female.—Head with two blunt teeth on the caudal margin of vertex, between the compound eyes; anal appendages lanceolate, measuring 5 mm. in length by 1 mm. in width.

Measurements: total length, male 70-75, female 74 mm.; length of abdomen, male 49-50, female 52 mm.; length of hind wings, male 47-49, female 47-53 mm.; length of stigma, male and female, 6-7 mm.

A fairly common species in Connecticut.

Connecticut.—New Haven, 19 July, 1900 (W. E. B.); Whitneyville, 18 July, 1904 (P. L. B.); Milford, 17 August, 1905 (H. L. V.); East Haven, 21 July, 1920, 30 July, 1921 (P. G.); New London, 6-22 June, 1921 (R. H. H.); Hamden, 1 May, 1927 (P. G.).

New England.—May 1-October 13.

Anax longipes Hagen

Synopsis of the Neuroptera of North America, 118: 1861.

This is a much larger species than *Anax junius*, and has very long femora, the hind femora being 16 mm. long in some; dorsum of the front without the dark marking of *junius*; superior anal appendages of the male as in Fig. 24, No. 4.

Measurements: total length, male 75-77, female 87 mm.; length of abdomen, male 49-55, female 55 mm.; length of hind wings, male 50, female 52 mm.; width of hind wings, male 13.5, female 14.5 mm.; length of hind femora, male 15-16, female 14 mm.

New England.—August 25-August 27.

Genus **Aeshna** Fabricius

Nymphs.—Hind margins of the head obtusely rounded; labial palpi (proximal segment) rounded or truncate at apex, there being a distinct internal tooth at apex; abdomen with lateral spines on segments 6-9, but without dorsal hooks.

Adults.—Wings with upper section of arculus shorter than lower; M_2 not making a sharp bend towards M_1 at end of stigma; R_s forked; several rows of cells between R_s and R supplement; triangle and supertriangle with cross-veins; basilar space without cross-veins; cubito-anal cross-veins 5-7; anal angle of hind wings dissimilar in the two sexes, the male with an anal triangle of 2 cells; thorax not uniform green; abdomen with only one lateral ridge per segment; inferior anal appendages of male entire.

Nymphs of the genus are also climbers upon vegetation in small lakes or ponds. The adults are very strong fliers and able to elude the most persistent collector at times; and are most commonly seen on the wing in Connecticut the latter part of the summer, from the middle of July on. The eggs are laid upon various plants beneath the surface.

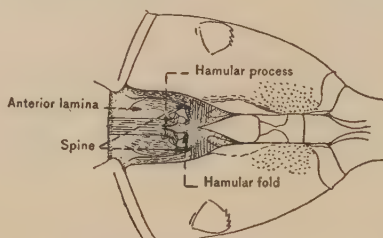


FIG. 25. Ventral view of the second abdominal segment of male *Aeshnas* showing details used in classification.

The following groups of the genus *Aeshna* have been recognized by Walker, 1912.

- Group 1. The *caerulea* group—a boreal or circumpolar group without representatives in Connecticut (p. 183).
- Group 2. The *juncea* group—including *juncea* (p. 183).
- Group 3. The *clepsydra* group—including *clepsydra*, *eremita* and *interrupta*, also *canadensis*, *verticalis* and *tuberculifera* (p. 183).
- Group 4. The *cyanea* group—including *umbrosa* and *constricta* (p. 189).
- Group 5. The *californica* group—without eastern representatives.
- Group 6. The *multicolor* group—including the eastern *mutata* (p. 192).

For literature pertaining to the genus see

Walker, E. M. University of Toronto Studies No. 11, 1912: 213 pages, 28 plates.

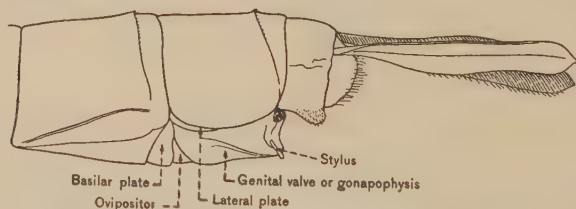


FIG. 26. Lateral view of terminal abdominal segments and ovipositor of female *Aeshnas* showing details used in classification.

Key to Species

Nymphs²²

- 1. Mentum extending to the hind coxae, and slightly exceeding the hind femora in length *tuberculifera*
- Mentum not reaching the hind coxae and shorter than the hind femora 2

²² Taken from Walker, 1912—*verticalis* is unknown as a nymph.

2. Mentum more than half as broad at base as at apex; ovipositor of female not usually reaching the posterior margin of segment 9 and never extending beyond it 3
Mentum of labium not, or scarcely more than, half as broad at base as at apex 7
3. Lateral spines present on abdominal segments 5 to 9 **eremita**
Lateral spines present on abdominal segments 6 to 9 4
4. Femora dark with three pale annuli; abdomen marked with irregular pale blotches on a darker ground color **interrupta**
Femora uniform in color; abdomen without irregular blotches, longitudinally striped 5
5. Lateral lobes of labium (labial palpi) truncate; lateral spines on abdominal segment 6 rudimentary, distant from the caudal margin of the segment by at least four times their own length **juncea**
Lateral lobes of labium not truncate, but curving to a prominent hook; lateral spines on segment 6 of the abdomen well developed, distant from the caudal margin by about their own length 6
6. Lateral margins of the mentum of labium not arcuate at base; dark median band of the abdomen not deepened about the dorsal punctae **clepsydra**
Lateral margins of the mentum of labium feebly arcuate at base; dark median band of the abdomen deepened about the dorsal punctae **canadensis**
7. Lateral lobes of labium tapering to a slender, slightly hooked point; legs uniformly colored; genitalia of female reaching caudad nearly or quite to the margin of segment 10 **constricta**
Lateral lobes of labium squarely truncate; femora and generally the tibiae also with alternate pale and dark annuli; genitalia of female never reaching caudad to the middle of segment 10 **umbrosa**

Adults, Males

1. Anal triangle 2-celled; spines of anterior lamina directed ventrad 2
Anal triangle 3-celled; spines of anterior lamina curved dorsad.. 8
2. Hamular processes long and slender, separated from the hamular folds which are reduced; spines of anterior lamina long, tapering to a fine point **juncea**
Hamular processes short, continuous with the hamular folds, which are well developed; spines of anterior lamina short and straight 3
3. Superior appendages with a prominent inferior basal tubercle; abdominal segment 10 entirely black **tuberculifera**
Superior appendages without a prominent inferior basal tubercle; abdominal segment 10 with 2 dorsal spots sometimes united 4
4. Lateral thoracic stripes either narrow and nearly straight or divided into two spots **interrupta**
Lateral thoracic stripes broad and never divided into two spots .. 5
5. Superior appendages each with a low inferior prominence at base, their apices rounded usually without a terminal spine, and their superior carina strongly elevated apically **eremita**
Superior appendages each without a low inferior prominence at base, their apices acute with a terminal spine and their superior carina elevated moderately apically 6
6. Fronto-clypeal suture with a black line; pale spots between the pale thoracic stripes very large **clepsydra**
Fronto-clypeal suture without a black line; pale spots between the pale thoracic stripes small 7
7. Cephalic margin of the first lateral stripe almost rectangularly sinuate; superior carina of the superior appendages denticulate **canadensis**

- Cephalic margin of the first lateral stripe not at all rectangularly sinuate; superior carina of the superior appendages not denticulate **verticalis**
8. First abdominal segment with a spinulose ventral tubercle; dorsum of segment 10 with a median and submedian tubercle; superior appendages each with a superior apical carina **mutata**
- First abdominal segment without a ventral spinulose tubercle; superior appendages without a superior apical carina, but with an anteapical internal tubercle and inferior spine 9
9. Lateral thoracic bands 1 mm. wide, and surrounded by a dark brown or blackish margin; two large basal spots on venter of abdominal segments 4, 5 and 6 **umbrosa**
- Lateral thoracic bands broader and not margined with dark brown or black; venter of abdominal segments 4, 5 and 6 without pale spots **constricta**

Females

1. Abdominal segment 1 with a distinct ventral tubercle **mutata**
- Abdominal segment 1 without a tubercle at base 2
2. Basal plate of ovipositor bilobed; lateral genital plates absent. **junceae**
- Basal plate of ovipositor not bilobed, its hind margin straight or slightly arcuate; lateral genital plates present 3
3. Styli shorter than the dorsum of segment 10; anal appendages less than 1.5 mm. broad, with apices rounded 4
- Styli as long as the dorsum of segment 10; anal appendages 1.5 to 2 mm. broad, apices acute 9
4. A black line present on fronto-clypeal suture 5
- No black line present on fronto-clypeal suture 7
5. Thoracic stripes of the mesepisterna absent or represented by an ill-defined spot on each; lateral thoracic stripes 1 mm. or less, often divided into two spots **interrupta**
- Thoracic stripes of the mesepisterna distinct, complete, or the upper end separated as a distinct spot; lateral stripes more than 1 mm. broad and not divided into two spots 6
6. First lateral or mesepimeral stripe not bent forward at the upper end; spots between lateral stripes not large **eremita**
- First lateral or mesepimeral stripe bent forward at the upper end; spots between lateral stripes large and often united with the bands **clepsydra**
7. Lateral thoracic stripes not margined with black; genital valves 2-2.6 mm. long, bearing a minute brush of hairs at their apices 8
- Lateral thoracic stripes margined with black, genital valves 2.1-3 mm. long, their apices without a minute brush of hairs. **umbrosa**
8. Metepimeral stripe curved ventrad at the upper end; the genital valves not ending abruptly **canadensis**
- Metepimeral stripe not curved ventrad at the upper end; groove of the genital valves ending abruptly some distance before the apices **umbrosa**
9. First lateral stripe with dorso-cephalic margin straight, the stripe not usually giving off a posterior offshoot; genital valves 3-3.5 mm. long, their apices with a minute brush of hairs **tuberculifera**
- First lateral stripe with the dorso-cephalic margin distinctly sinuate, the upper end giving off a small posterior offshoot; second lateral or metepimeral stripe rapidly widened at the upper end; genital valves 4-4.5 mm. long, their apices without a brush of hairs **constricta**

Group 1. The CAERULIA Group

***Aeshna caerulia septentrionalis* Burmeister**

Handbuch der Entomologie II: 839; 1839.

The only species in this group likely to be found in Connecticut is *caerulia* var. *septentrionalis*, the anal appendages of which are shown in Fig. 27.



FIG. 27. *Aeshna caerulia septentrionalis*, anal appendages and color pattern of thorax. (From Howe.)



FIG. 28. *Aeshna juncea*, anal appendages and color pattern of thorax. (From Howe.)

Group 2. The JUNCEA Group

***Aeshna juncea* Linnaeus**

Although this species has been reported from Connecticut, the report has been found to be incorrect, and so far as known to the writer, no specimens have been captured in this State. The color pattern of the thorax and structure of the anal appendages are shown in Fig. 28.

Group 3. The CLEPSYDRA Group

***Aeshna canadensis* Walker**

Canadian Entomologist, 40: 382, 389: 1908.

Adult, male.—Color brown, marked with green or dark blue.

Head: front green or blue, T-spot of the front with upright about as wide as the cross-arm and convex in front; ocellar area dark brown, rear of head black.

Thorax: brown with blue or green markings, dorsal bands of the mesepisterna 3.6 by about 1 mm. sometimes invisible in pinned specimens (Fig. 29; Fig. 38, No. 6); mesepimeral pale stripe with cephalic margin bent caudad at middle, making the dorsal half of the stripe about half as wide as the ventral; a small pale spot midway between metathoracic spiracle and wing base; metepimeral stripe with somewhat irregular margins, and widened at wing bases; legs brown, tarsi and ventral surfaces of the femora darker; wings hyaline, stigma brown.

Abdomen: marked with blue and yellow; only the median dorsal spots are yellow, the rest are blue; segment 10 with a prominent tubercle on dorso-meson; anal appendages (Fig. 29) dark brown, the superiors in dorsal view with gently curved lateral margins, the mesal margins nearly parallel to the lateral margins on the distal two-thirds, the margins bent laterad, and the appendage contracted in the basal third; in lateral view the dorsal carina of the superiors becomes more prominent on the distal fourth of the appendage and has 5 or 6 indefinite denticles; tips of superiors acute, bent ventrad; inferior appendage about three-fifths as long as the superiors and with two upcurved spines on the blunt apex.

Female.—Most of the blue color pattern of the male usually replaced by green but there is considerable variation; the dorsal mesepisternal pale stripes are less definite than in the male; wings sometimes flavescent; superior anal (Fig. 29) appendages bluntly pointed, the margins gently arcuate.



Fig. 29. *Aeshna canadensis*, anal appendages and color pattern of thorax. (From Howe.)

Measurements:²³ total length, male 69, female 67 mm.; length of abdomen, male 46-51, female 45-49 mm.; length of hind wings, male 43, female 42-47 mm.; width of hind wings, male 13-14, female 13-14 mm.; length of stigma, male 3-3.5, female 3.7-4.3 mm.

Connecticut.—Litchfield, 22 August, 1915 (L. B. W.).
New England.—June 22-September 26.

Aeshna clepsydra Say

Journal of the Academy of Natural Sciences of Philadelphia, 8: 12: 1839.

Nymph.—Color brown with distinct longitudinal pale stripes.

Head: mentum about three-fifths as wide at base as at apex; basal segment of the palpi forming a broadly curved hook, not at all truncate; caudo-lateral margins of the head broadly rounded.

²³ Walker, E. M., North American Dragonflies of the Genus *Aeshna*, p. 141.

Thorax: femora uniform brown; wing-cases just reaching segment 5 of the abdomen.

Abdomen: with a dark mid-dorsal stripe flanked on either side by a pale stripe of about the same width or a little less; a wide pale stripe on either side just above the lateral keels; lateral spines present on segments 6-9 inclusive, those on 6 reaching half way to the caudal margin of the segment, 7 just reaching the caudal margin, and those of segments 8 and 9 reaching considerably beyond those margins.

Measurements: total length, 36 mm.; length of abdomen, 20 mm.; length of hind femora, 6 mm.; metathoracic wing-cases, 8 mm.; length of mentum, 6.5 mm., greatest width, 5, width at base, 3 mm.

Described from a nymph collected in Hamden, 1923, and agreeing in all particulars with that described as *clepsydra* by Walker (1912).

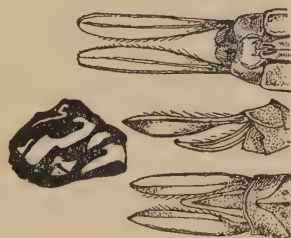


FIG. 30. *Aeshna clepsydra*, anal appendages and color pattern of thorax. (From Howe.)

Adult, male.—Preocular band somewhat wider at the base of the antennae than one of the ocelli; narrowed to a fine line on the sides; T-spot very heavy, the crossbar strongly convex in front 2.5-3 mm., stem .75-1.3 mm.

Thorax: color pattern as in Fig. 30 being different in marking from all other species of *Aeshna*; anal triangle of the hind wings with two cells.

Abdomen: auricles with 3, rarely 4 teeth; spines of the anterior lamina short and blunt, directed ventrad and caudad, not projecting below the tergal margins; hamular processes directed mesad and cephalad with bluntly pointed apices and without a distinct apical tubercle; hamular folds continuous with the processes but distinctly marked off from them, ear-shaped, the outer margins straight, parallel, or slightly divergent, inner margins closely approximate. Superior anal appendages as in Fig. 30. Abdomen with large blue spots, 9 and 10 each with a large dorsal blue spot; 8 with small cephalo-lateral and large caudo-dorsal; 4-7 with two cephalo-lateral very irregular spots and a caudo-dorsal; 3 with large lateral spot occupying the cephalic half of the lateral surface,

a spot just behind the median transverse ridge and an apical ring; second segment with two lateral spots; segment I with one spot on each side.

Female.—Color pattern as shown in Fig. 30; Fig. 38, No. 1.

Head: line of contact of eyes longer than the vertex; distance from hind margin of vertex to the frontal vesicle more than 2 mm.; T-spot of front with the stem as wide or wider than the cross-arm; fronto-clypeal suture brown.

Thorax: wings not flavescent; fork of R_s symmetrical; super-triangular areas with 2-3 cross-veins; thoracic bands very irregular, particularly the lateral ones.

Abdomen: about 5 times as long as the thorax; superior anal appendages 1 mm. in width by 5 in length, widest about the middle, the tips rounded; ovipositor without bilobed basal plates, the lateral plates visible only at base of the segment; lateral valves not flattened beneath, but broadly sulcate about .5 mm. from tip; tip with a pencil of hairs ventrad of styli; styli less than 1 mm. long and much shorter than the dorsum of segment 10.

Measurements: total length, male 66, female 69 mm.; length of abdomen, male 45-59, female 47 mm.; length of hind wings, male 40-47, female 44 mm.; width of hind wings, male 12-13, female 13-14 mm.

Connecticut.—Stonington, 8 August, 1906 (J. A. H.); Litchfield, 19 September, 1908, 22 August, 2 September, 1910 (L. B. W.); Mansfield, 16 August, 5 October (J. A. M.).

New England.—July 6-October 9.

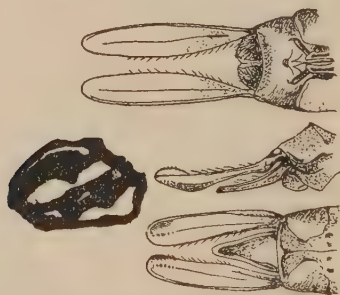


FIG. 31. *Aeshna eremita*, anal appendages and color pattern of thorax. (From Howe.)

Aeshna eremita Scudder

Proceedings of the Boston Society of Natural History, 10: 213: 1866.

This species has not yet been found in Connecticut but very possibly occurs in the northern part of the State. Structure of the anal appendages and color pattern are shown in Fig. 31. It flies from August to October.

***Aeshna interrupta* var. *interrupta* Walker**

Canadian Entomologist, 40: 381, 387, 450, Pl. 10, Fig. 3: 1908.

A species not yet found in Connecticut. Structure of anal appendages and color pattern of thorax represented in Fig. 32. It flies from July to September.

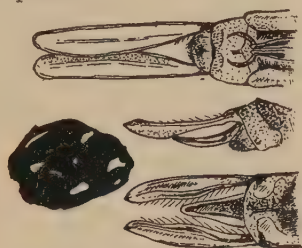


FIG. 32. *Aeshna interrupta*, anal appendages and color pattern. (From Howe.)

***Aeshna tuberculifera* Walker**

Canadian Entomologist, 40: 385: 1908.

Adult, male.—Color brown to black with green or blue markings.

Head: preocular band usually less than twice as broad as the first antennal segment; T-spot 2.3-3 mm., stem .4-.75 mm. broad in front, .8-1 mm. behind, sides generally straight and more or less divergent.

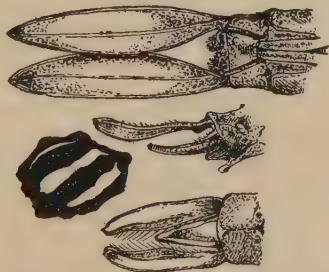


FIG. 33. *Aeshna tuberculifera*, anal appendages and color pattern of thorax. (From Howe.)

Thorax: color pattern as in Fig. 33; dorsal mesepisternal bands pea-green, nearly straight, 3.5-4 mm. long, .75-1 mm. broad at middle, lower ends pointed; lateral bands blue above, fading into pale green below; first lateral band 1-1.5 mm. broad in lower third, narrowing to about 1 mm. in upper half; metathoracic band 1.3-1.5 mm. broad; anal triangle of wings 2-celled.

Abdomen: Auricles with 4 or 5 teeth, spines of anterior lamina short and blunt, not reaching back to the hamular folds; hamular processes short and very broad, directed mesad, the cephalo-ventral surfaces flat, caudo-mesal margins arcuate, apices bluntly obtuse-angulate with no indication of a tubercle, hamular folds continuous with hamular process not so closely approximate behind as in *clepsydra* or allied species; margins thickened, outer margins parallel; color pattern as in Fig. 38, No. 2; anal appendages as in Fig. 33.

Female.—Head: distance from caudal margin of the vertex to the frontal vesicle about 3.5 mm.

Thorax: supratrangular space of wings with 2-3 cross-veins; distal margin of the anal loop as long as the proximal margin of the triangle; wings very slightly flavescent at base and along the costal margin.

Abdomen: nearly five times as long as the thorax; superior anal appendages 7 mm. long by 1.5 mm. wide, widest before the middle and tapering from the widest point to a blunt-pointed apex; ovipositor large, the basal plates not bilobed; lateral plates visible for about half the length of segment 9; lateral gonapophyses broad, not flattened or sulcate beneath, and with a pencil of hairs at tip beneath the styli; styli 1-1.5 mm. long, being about the length of the dorsum of segment 10.

Measurements: total length, male 72, female 71 mm.; length of abdomen, male 47-52.5, female 45-54.5 mm.; length of hind wings, male 45.5-49 mm., female 44-50.5 mm.; width of hind wings, male 13-14.5, female 12-14.5 mm.

Connecticut.—Scotland, 25 July, 1904 (B. H. W.); Litchfield, 3, 31 August, 1908 (L. B. W.).

New England.—July 25 to September 23.

***Aeshna verticalis* Hagen**

Synopsis of the Neuroptera of North America, 122: 1861.

Adult, male.—Color dark brown, marked with green and blue.

Head: line of contact of the compound eyes longer than the vertex; T-spot of the front with a very wide cross-arm and the upright expanded at base.

Thorax: wings with anal triangle two-celled; distal side of the anal loop equal in length to the proximal side of the triangle; lateral thoracic stripes (Fig. 34) of the mesepimera 1.5 mm. wide below, the upper half considerably narrower.

Abdomen: first segment without a distinct ventral tubercle; length of abdomen 4 times that of the thorax; abdominal spots blue (arranged as in Fig. 38, No. 5); superior anal appendages (Fig. 34) flat, the tips acute and slightly decurved, a dorsal carina present on each; length 5 mm.; greatest width 1 mm.; inferior appendage triangular, 2.5 mm. long by 1 mm. wide at base; provided with 2 minute recurved, approximate teeth at the apex.

Female.—Color similar to the male; pattern as shown in Fig. 34.

Head: distance from the hind margin of the vertex to frontal vesicle more than 2 mm.

Thorax: wings with R_s fork symmetrical; supratrangular area with 3 cross-veins; lateral thoracic bands 1.7 mm. broad below, narrowed to 1 mm. above.

Abdomen: first segment without ventral tubercle; about four times as long as thorax; superior anal appendages not over 1 mm. in width and rounded at tips. Ovipositor without bilobed basal plate, the lateral plates almost or entirely invisible; lateral valves flattened and sulcate beneath, and with a pencil of hairs at tip; styli .6 mm. long, not as long as dorsum of segment 10.

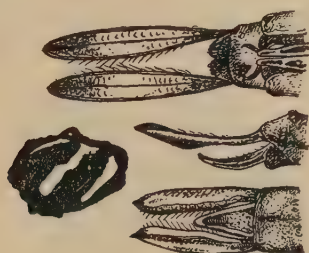


FIG. 34. *Aeshna verticalis*, anal appendages and color pattern of thorax. (From Howe.)

Measurements: total length, male 62-68, female 60-63 mm.; length of abdomen, male 47, female 47-50 mm.; length of hind wings, male 45, female 43-46 mm.; width of hind wings, male 14, female 14 mm.

Connecticut.—New Haven, 26 September, 1903 (W. E. B.); Scotland, 25 July, 1904 (B. H. W.); Salisbury, 27 August, 1904; New Canaan, 14 September, 1905 (W. E. B.); Twin Lakes, 20 August, 1921 (P. G.); Litchfield, 19 September, 1908 (L. B. W.).

New England.—July 17-October 2.

Group 4. The CYANEA Group

Aeshna constricta Say

Journal of the Academy of Natural Sciences of Philadelphia, 8: 11: 1839.

Adult, male.—Color dark brown marked with green and blue.

Head: line of contact of the compound eyes longer than the vertical triangle; distance from the hind margin of the vertical triangle to the frontal vesicle more than 2 mm.; cross-arm of frontal T wider than the upright; preocellar transverse band narrow.

Thorax: wings with fork of R_s symmetrical; supratrangular space with 2-3 cross-veins; anal triangle composed of 3 cells; distal side of the anal loop as long as the proximal side of the triangle; thoracic stripes (Fig. 35) green, the mesepimeral or first lateral stripe 6 mm. by 1 mm., with a small caudal projection at the upper end; dorsal stripes somewhat cuneiform, 1.5 mm. wide at the dorsal end; metepimeral stripe similar to the mesepimeral, but a trifle shorter, two or three small dots present between the lateral stripes; paraptera green, mesa- and metanota blue (Fig. 38, No. 4).

Abdomen: four times as long as the thorax; first abdominal segment without a ventral projection; superior anal appendages (Fig. 35) 5-5.5 mm. in length with a sharp ventro-apical tooth and distinct latero-ventral carinae; length of inferior appendages 2-3 mm., width at base 1 mm., at tip .5 mm., the tip with 2 small upturned teeth.



FIG. 35. *Aeshna constricta*, anal appendages and color pattern of thorax. (From Howe.)

Female.—Color similar to the male.

Head: similar to the male.

Thorax: with lateral stripes nearly 2 mm. in width, and a prominent caudal offshoot at the upper end (Fig. 35).

Abdomen: lateral valves of ovipositor with prominent lateral carinae, and without a pencil of hairs at tip; the styli longer than the dorsum of segment 10; lateral lobes visible, basal lobes not bilobed. Superior anal appendages 6.5 mm. long by 2 mm. broad, acutely pointed, widest proximad of the middle.

Measurements: total length, male 65-66, female 64 mm.; length of abdomen, male 50-51, female 45 mm.; length of hind wings, male 43-46, female 45 mm.; width of hind wings, male 13-14, female 15 mm.

Connecticut.—Litchfield, 7 September, 1910 (L. B. W.).

New England.—June 19-October.

***Aeshna umbrosa* Walker**

Canadian Entomologist, 40: 380, 390: 1908.

Nymph (Pl. III, Fig. 1).—Color dark brown or buff-colored, without definite stripes.

Head: mentum (Pl. VI, Fig. 5) less than twice as wide at base as at apex; the labial palpi (Fig. 7, No. 5) squarely truncate at apex of proximal segment; labium not extending to the metacoxae.

Thorax: rather prominent projections over the procoxae; legs uniform brown or indefinitely marked with pale rings on femora and tibiae; wing-cases extending to the middle of segment 4 in full-grown specimens.

Abdomen: with lateral spines on segments 6-9 inclusive, uniform brown in color.

Measurements: total length, 46 mm.; length of abdomen, 27 mm.; length of hind femora, 8 mm.; length of mentum, 7 mm.

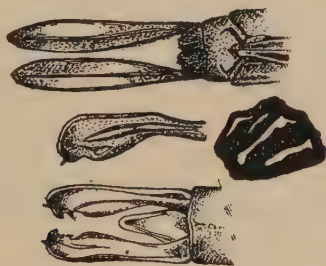


FIG. 36. *Aeshna umbrosa*, anal appendages and color pattern of thorax. (From Howe.)

Described from a nymph collected at Litchfield, Connecticut, July 13, 1922, and the exuviae of a reared nymph collected in Hamden, Connecticut, July, 1923, emerging July 26, 1923.

Adult, male (Pl. XVIII, b).—Color dark brown, marked with yellowish green.

Head: occiput one-third to one-half as long as the line of contact between the eyes; face brown, the lateral margins next the compound eyes pale; no black stripe on the fronto-clypeal suture.

Thorax: lateral pale stripes (Fig. 36; Fig. 38, No. 3) less than 2 mm. wide, usually about 1.5 mm., yellowish green or buff surrounded by dark brown, the dorsal bands yellowish green, the cephalic ends pointed and separated by about 4 mm.; remainder of the thorax uniform dark brown; anal triangle of the hind wings 3-celled.

Abdomen: strongly constricted at segment 3, the color pattern

as in Fig. 38, No. 3; pale marks greatly reduced and mostly green or buff; large bluish spots are present below the carinae on segments 4 to 8; dorsum of segment 10 smooth, without a median spine; lateral carinae of segments 6 and 7 decidedly sinuate; anal appendages (Fig. 36) with a prominent subapical tooth, directed ventro-mesad, each appendage emarginate and with a tuft of hairs proximad of the tooth.

Female.—Color similar to the male.

Head: distance from the hind margin of the vertex to the frontal vesicle more than 2 mm.

Abdomen: superior anal (Fig. 36) appendages approximately 1 mm. in width, the tips pointed; basal plates of the ovipositor not distinctly bilobed, the caudal margin sinuate; lateral plates visible for about half the length of segment 9; lateral valves with a conspicuous lateral carina which curves onto the ventral surface; ventral surface of the valves deeply sulcate at apices, the tips without conspicuous pencils of hairs; styli 1 mm. or less in length, or considerably less than the length of the dorsum of segment 10.

Measurements: total length, male 74, female 60-69 mm.; length of abdomen, male 50, female 45-47 mm.; length of hind wings, male 43, female 44-48 mm.; width of hind wings, male 13, female 13-15 mm.

Connecticut.—New Haven, 18 July, 1905 (H. Lange); September, 1920, 18 August, 1921 (P. G.); Westville, 11 August, 1913 (L. B. R.); Plainville, 25 June, 1921 (W. E. B.); Twin Lakes, 20 August, 1921 (P. G.); Storrs, 5 October, 1923 (J. Cronin); Litchfield, 19 August, 1909, 22, 24 July, 1910 (L. B. W.).

New England.—May 6-November 1.



FIG. 37. *Aeshna mutata*, anal appendages and color pattern of thorax. (From Howe.)

Group 6. The MULTICOLOR Group

Aeshna mutata Hagen

Synopsis of the Neuroptera of North America, 124: 1861.

Not yet found in Connecticut but details of structure and color pattern of thorax may be seen in Fig. 37.

Genus *Nasiaeschna* Selys

Nymphs.—Head with obtusely angulate caudo-lateral margins; proximal segment of labial palpus truncate at apex; mental cleft open; lateral spines on segments 5-9, and dorsal hooks represented on all segments but more prominent on segments 6-9.

Adults.—Wings with cephalic section of arculus longer than the caudal; M_2 not making a sharp bend distad of stigma; R_s

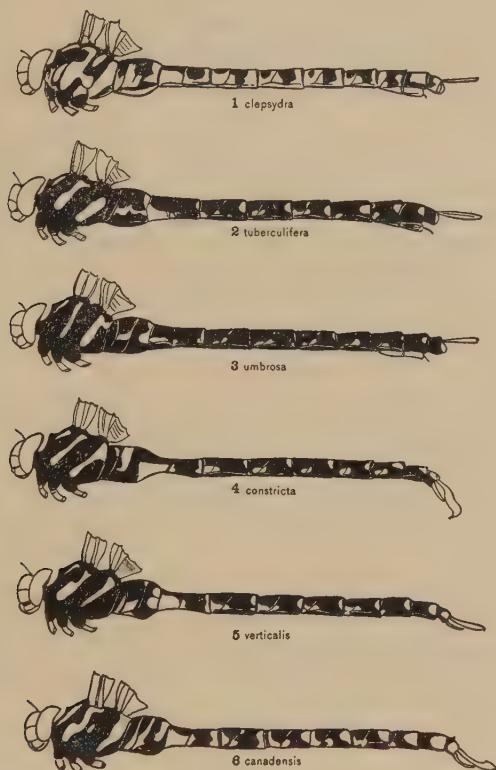


FIG. 38. Color pattern of abdomen and thorax of six species of *Aeshna*.

forked and only one row of cells between it and the supplementary sector; triangle and supertriangle with cross-veins; basilar space free; anal loop with about 7 cells; cubito-anal cross-veins 3; anal angle of hind wings dissimilar in the two sexes, the anal triangle composed of 3 cells; thorax not uniform green; abdomen with a single lateral ridge per segment; inferior appendage of male entire.

Adults of the only representative of the genus appear on the

wing much like other Aeschnidae, particularly Aeshna species. The only specimen in the collection of the Experiment Station was taken at Litchfield along the slow-flowing outlet of Bantam Lake. The species was found flying back and forth over a given "beat," keeping well to the middle of the stream. In contrast to most other Aeshnids, the species is apparently most common in June or the early part of the summer.

Nasiaeschna pentacantha Rambur

Histoire naturelle des insectes. Neuroptères, 208: 1842.

Nymph (Pl. III, Fig. 2).—Color very dark brown, tarsal segments yellowish.

Head: labium with mentum extending between the mesocoxae, the median lobe with a closed median cleft, and setose distal margin; proximal segments of palpi with blunt projections provided with an inturned hook at apex and with small rounded teeth on the mesal margins; antennae with the 6th segment longest, segments 3-6 being pale with apices of 5 and 6 dark; two tubercles on the head about 1 mm. above the bases of the antennae, and separated from one another by less than 1 mm.; the lateral margins of the head each with a similar tubercle; dorso-lateral angles of the eyes separated by about 1.5 mm.

Thorax: pronotum with four distinct elevations on the dorsal surface, the lateral margins flaring; propleura with two blunt projections above each procoxa. Meso- and metapleura also with several slight elevations resembling tubercles and projections (smaller than those over procoxae) above meso- and metacoxae; legs distinctly carinate, especially the femora, which are sometimes also provided with furrows.

Abdomen: lateral keels with spinous projections on segments 5-9 inclusive, and mid-dorsal projections on segment 5 or 6-9; anal appendages consisting of very short laterals (less than 1 mm.) and much longer dorsal and ventral appendages, approximately 3 mm. in the specimen studied.

Cuticle decidedly granular in appearance under the microscope, due to minute setae.

Measurements; immature nymph: total length, 37 mm.; abdomen, 25 mm.; greatest width, 7 mm.; hind femur, 4.5 mm.; width of head across the eyes, 7 mm.; mentum, 6 mm. long by 2.5-4.5 mm. wide; length of metathoracic wing-cases, 4.5 mm.

Described from a specimen obtained from Dr. P. P. Calvert, taken at Go Home Bay, Ontario, Canada, 1909.

Adult, male (Pl. XVIII, a).—Color dark brown marked with green.

Head: clypeus, labrum and labium light green; cephalic surface of front green, dorsal surface bluish, vertex and occiput dark brown, postgenae lighter on sides; antennae black; compound

eyes contiguous on the meson for about 2 mm.; caudal surface of the occiput with a small tubercle.

Thorax: brown marked with three wide green stripes on each side; green stripe of the mesepisternum about 1 mm. wide by 4 mm. long and considerably widened near the wing bases; a broad green stripe occupying most of the mesepimera and part of the metepisterna about 2 mm. wide by 7 mm. long, the cephalic border of the stripe broken at middle, the dorsal half of margin much further caudad; green stripe of the metepimera 1.5 by 6 mm. long; venter of thorax mostly brown with some green behind the metacoxae; legs black or brown, the femora and tibiae each with two rows of short spines beneath, claws with ventral tooth at middle; wings (Pl. VIII, Fig. 3) clear, with 16-18 ante- and 16-17 postnodal cross-veins in the front wings, the triangles with 2 to 3 cross-veins in the front wings and with 3-4 cells in the hind; anal loop of hind wings consisting of 7-9 cells; stigma surmounting $2\frac{1}{2}$ to $3\frac{1}{2}$ cells in the front wing and about 4 in the hind; antenodal cross-veins of the second series pale in color.

Abdomen: brown in dried specimens with green on the sides of 2 and 3 at least; auricles of 2 very prominent, the caudal margins of each bearing about 10 spines; terga 2-8 with transverse furrows; 3-8 with a single lateral carina on each side; a prominent dorsal carina on terga 3-10; superior anal appendages about 3.5 mm. long and black; in dorsal view considerably expanded just beyond middle; inferiors entire, with two small teeth at the apex.

Female.—Differs from the male in not having the face concave; anal appendages brown, a little longer than the last segment, short, thin, straight and pointed.

Measurements: total length, male 72 mm.; length of abdomen, male 51-55, female 47 mm.; length of hind wings, male 45-48, female 50 mm.; width of hind wings, male 12 mm.

A single male taken at Breakneck Pond, Union, Conn., June 24, 1921, by Mr. S. W. Bromley, belongs here. Also one male from Litchfield, 14 June, 1925 (P. G.).

New England.—June 14-July 9.

Genus *Epiaeschna* Selys

Nymphs.—Hind angles of the head obtusely rounded; proximal segments of labial palpi sharply truncate at tip, with a strong internal hook; antennae with six segments; abdomen with lateral spines on segments 5-9 and with an obtuse mid-dorsal ridge, but no hooks.

Adults.—Wings with upper half of arculus as long as lower; M_2 not making a sharp bend towards M_1 at distal end of stigma; R_s forked; only two rows of cells between R_s and supplementary radius; triangle and supertriangle with cross-veins, basilar space

free; cubito-anal cross-veins 3-5; anal loop with 2 rows of cells; anal angle of hind wings dissimilar in the two sexes, the anal triangle of the male with 3 cells; thorax not uniform green; abdomen with only one lateral ridge per segment; inferior anal appendages of male entire.

Very little is known of the habits of the genus, either adult or nymph. Needham (1901) says of the one species *heros*: "Its strikingly large size, and its habit of flying into houses not unfrequently, and its apparent migrations in numbers, have made it a rather well known species."

***Epiaeschna heros* (Fabricius)**

Supplementum Entomologiae Systematicae, 285: 1798.

Nymph.—Color dark brown.

Head: granular above, the sides behind the eyes somewhat angular; antennal segments 3, 5, and 6 equal in length and 1, 2, and 4 also equal; labium extending to the middle coxae, the inner margins of the labial palpi coarsely toothed (Pl. VI, Fig. 2), much more so than any other member of this family.

Thorax: projections over the procoxae prominent; pronotum granular.

Abdomen: lateral spines prominent on segments 5 to 9 and a dorsal ridge on segments 8 to 10; terminal appendages with the superior and inferiors subequal, the lateral appendages about half this length; ovipositor of the female as long as segment 9.

Measurements: total length, about 47 mm.; abdomen, 30 mm.; hind femora, 7 mm.; wing-cases, 10-11 mm.; mentum, 8.5 mm. long by 5.75 mm. wide at widest portion.

Specimens in the Museum of Comparative Zoology examined.

Adult, male.—Color brown, marked with green.

Head: labium brown, green at sides; clypeus green above, front brown, with green ventral border and two green spots on dorsal surface; frontal vesicle bilobed, green between the lobes; vertex greenish yellow, rear of the head yellow below; black above.

Thorax: prothorax brown, meso- and metathorax brown and green, the dorsal mesepisternal stripes pointed below, expanded above, being 1 mm. wide at middle and 1.5 mm. at the upper end; first lateral or epimeral green stripe 2 mm. wide in its ventral half, somewhat narrower in its dorsal half, with a notch at middle on the cephalic border, length 7 mm.; metepimeral stripes 2 mm. broad, the borders straight and parallel; paraptera of metathorax green, and a small green spot on metepisternum just ventrad; mesoparaptera brown; base of wings, meso- and metanota marked with green; legs black, the coxae and trochanters but little lighter; femora with double rows of short spines beneath; front tibiae with about 12 flat scales in cephalic row, meso- and metatibiae with 12-14 setae in each of the two rows. Tarsi with distal segment as long as the first two together; wings, Fig. 39, slightly flaves-

cent, tips sometimes darker, the nodus, antenodal veins of the second series and the R-M cross-veins almost white, remaining veins brown; anal triangle composed of 3 cells; cubito-anal cross-

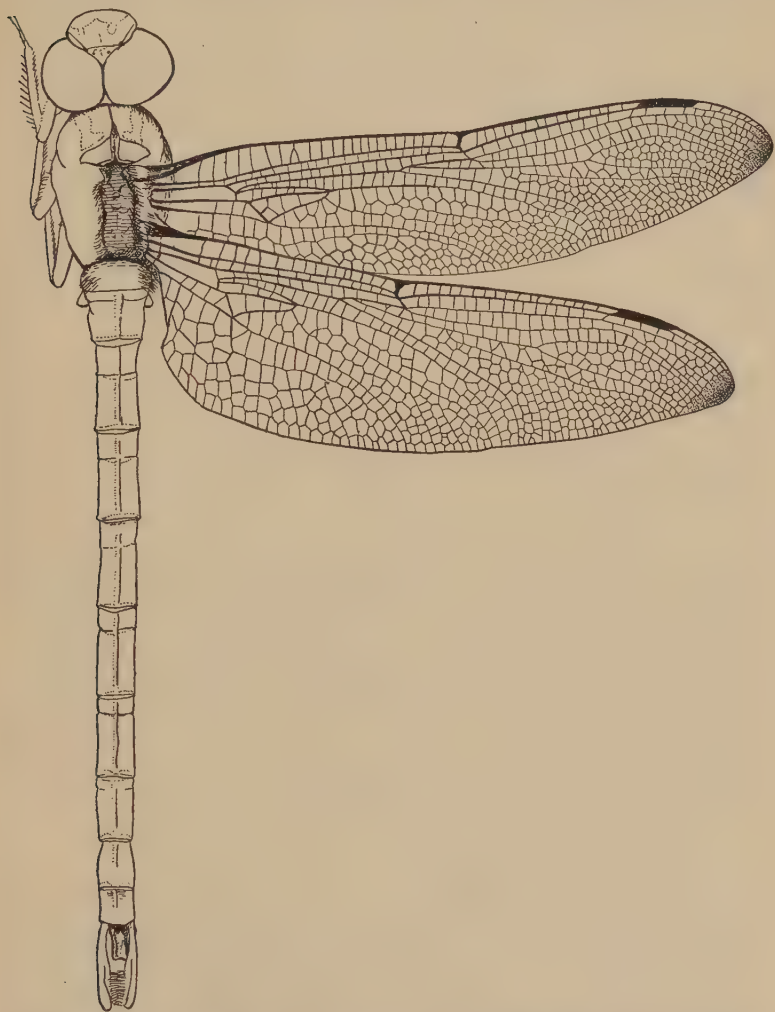


FIG. 39. *Epiaeschna heros*. Tracing from photograph mainly to show wing venation and general structure of body. Left wings and right legs removed ($\times 1.4$).

veins 3-5, supertriangular spaces with 3-5 cross-veins; not more than 2 rows of cells between R_s and R supplement; stigma supported by 4-6 cross-veins.

Abdomen: green and brown; margin of the auricles continuous with a ridge which extends ventrad to apex of the genital lobes; latero-ventral carinae of 3-8, and dorsal carinae of 2-9 minutely serrate; median transverse furrows present on segments 2-8; terga 2-8 not meeting on the ventro-meson by .5-1 mm., the sterna therefore exposed; 10th tergum with a conspicuous dorsal median tooth; superior anal appendages 7-8 mm. long, contracted at base and with a blunt ventral tubercle; distal two-thirds with a dorsal carina, the tips bluntly pointed and the mesal margin of the apical half densely setose; inferior appendage half as long as the superiors, the dorsal surface excavated, the tips with two sharp, well-separated, recurved teeth; accessory genital appendages composed of two short hooks on segment 1, short nodular hamules, and genital lobes projecting but little below the margins of the tergum. Color pattern consisting of narrow basal median and apical green rings on terga 2-7; basal and apical rings on 8, apical ring on 9, and sometimes the sides of 10 also green (dried specimens).

Female.—Color entirely brown in specimens at hand.

Head: caudal margin of the vertex between the compound eyes with a U-shaped emargination; wings with rounded anal angles.

Abdomen: with terga approximate on ventro-meson of 7, not usually contiguous on the remaining segments; visible part of ninth sternum triangular, projecting ventrad and with a mesal carina; superior anal appendages about 7 mm. long by 2 mm. broad, lanceolate, the tips broadly rounded; ovipositor with a conspicuous carina on the lateral valves, the lateral plates visible for one-third the length of 9; styli a little more than .7 mm. long.

Measurements: total length, male 85, female 87 mm.; length of abdomen, male 57-59, female 56-58 mm.; length of hind wings, male 53-54, female 55-57 mm.; width of hind wings, male 15-16, female 15-16 mm.; length of stigma, male 4.5-5, female 5.5-6 mm.

Connecticut.—New Haven, 24 May, 1912 (H. B. K.), 28 July, 1914 (Q. S. L.); North Branford, 9 June, 1912 (B. H. W.); Lyme, 16 June, 1918 (M. P. Z.); Storrs, 1925 (A. Bulbulian).

New England.—May 24-September.

Family LIBELLULIDAE Rambur

Owing to a close similarity between the Cordulinae and Libellulinae, it has been impossible to make an entirely satisfactory key to the subfamilies as they stand. To overcome this difficulty, a key to tribes has been constructed which, it is hoped, will enable beginners to determine more accurately the systematic positions of species of the larger groups.

The family divisions given by Tillyard are listed below, together with the genera occurring in this locality. The Sympetrini and Leucorrhiniini have been combined because of difficulties encountered in separating them with the usual characters.

Nymphs of the family are in general characterized by the mask-like labium which covers the front of the head up to the antennae.

Adults also have a mask, the palpi meeting in a line on the meson.

Subfamily CORDULINAE

- | | |
|-----------------|--|
| 1. MACROMIINI | <i>Macromia, Didymops</i> |
| 2. EUCORDULIINI | <i>Somatochlora, Cordulia, Tetragoneuria, Neuro-, Doro-, Helo- and Epicordulia, Williamsonia</i> |

Subfamily LIBELLULINAE

- | | |
|-----------------|---|
| LIBELLULINI | <i>Plathemis, Libellula</i> |
| PALPOPLEURINI | <i>Perithemis</i> |
| BRACHYDIPLACINI | <i>Nannothemis</i> |
| SYMPETRINI | <i>Erythrodiplex, Pachydiplex, Sympetrum, Erythemis, Celithemis, Leucorrhinia</i> |
| TRAMEINI | <i>Tramea, Pantala</i> |

Subfamilies CORDULINAE and LIBELLULINAE

Key to Tribes

Nymphs

- | | |
|---|-------------------------|
| 1. Head with a prominent frontal horn | MACROMIINI, p. 201 |
| Head without a prominent frontal horn | 2 |
| 2. Lateral spines of abdominal segment 8 as long as segment 9 or longer; without dorsal hooks on 5-7 | TRAMEINI, p. 288 |
| Lateral spines of abdominal segment 8 shorter than the length of segment 9 or absent; if with long lateral spines as above, then with dorsal hooks on segments 5-7 | 3 |
| 3. Superior terminal appendage as long as the inferiors (Nannothemis) | BRACHYDIPLACINI, p. 259 |
| Superior terminal appendage not so long as the inferiors | 4 |
| 4. Length of the labial palpus from lateral point of articulation with the mentum to base of movable spine or hook (distal segment one-fourth to one-fifth longer than the distance from the articulation to the internal angle); also longer than the distance from the point of articulation to the base of the mentum (Fig. 66) (Perithemis) | PALPOPLEURINI, p. 257 |
| Length of labial palpus from lateral point of articulation with the mentum to base of movable spine or hook usually shorter than the distance from articulation to the internal angle (occasionally slightly longer but not one-fourth or one-fifth longer); usually shorter than the distance from the articulation to the base of mentum | 5 |
| 5. Length of segment 10 plus the terminal appendages measured on the mid-ventral line shorter than segment 9; lateral terminals nearly or quite as long as the dorsal, never less than half as long | EUCORDULIINI, p. 206 |
| Length of segment 10 plus the terminal appendages measured on the mid-ventral line as long or longer than segment 9; lateral terminals usually not over half as long as the dorsal | 6 |

6. Abdomen lanceolate in outline, not abruptly but slowly narrowed to the tip; hind margins of the eyes viewed from above before the middle of the head; labium of characteristic form as shown in Plate VII, Figs. 1, 5; length full-grown, more than 21 mm.

LIBELLULINI, p. 240

- Abdomen not lanceolate in outline, abruptly narrowed at the caudal end; hind margins of the eyes viewed from above, at, or behind the middle of the head; labium not as shown in Pl. VII, Figs. 1, 5; nymphs of small size not measuring over 21 mm.

SYMPETRINI, p. 261

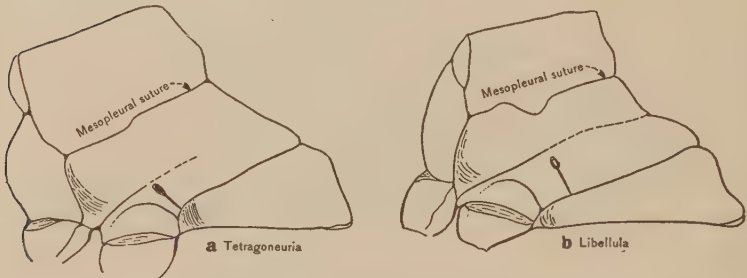


FIG. 40. Thoraces of representative Cordulinae (a), and Libellulinae (b), showing differences in curvature of the mesopleural suture.

Adults

1. Front margins of the triangle of the front wings broken (Pl. XII, Fig. 2) BRACHYDIPLACINI, p. 259
- Front margins of the triangle of the front wings continuous 2
2. Proximal side of the triangle of the hind wings distad of the arculus; anal loop not foot-like in the hind wings (Pl. XI, Fig. 1) MACROMIINI, p. 201
- Proximal side of the triangle of the hind wings in line with or proximad of the arculus; anal loop foot-like in the hind wings 3
3. Hind wings 15 to 20 mm. wide at base (Pl. XV, Nos. 1, 2); dorsal carina distinct on segments 3 to 8 of the abdomen; proximal and distal margins of the stigma not parallel TRAMEINI, p. 288
- Hind wings less than 15 mm. wide at base; if approaching 15 mm. in width, then either without a distinct carina on all the segments 3 to 8, or with the proximal and distal margins of stigma parallel 4
4. M_2 with a decided bend at middle (Pl. XV, Fig. 3) LIBELLULINI, p. 240
- M_2 without a decided bend at middle 5
5. Caudal margin of pronotum entire and without a long fringe of hairs; mesopleural suture as in Fig. 40, a; colors usually metallic blue or green EUCORDULINI, p. 206
- Caudal margin of pronotum bilobed and with a long fringe of hairs; mesopleural suture as in Fig. 40, b; colors not usually metallic blue or green 6
6. Sexes strongly dimorphic in wing color; hind wings not over 20 mm. in length (Pl. XIII, Figs. 2, 4) PALPOPLEURINI, p. 257
- Sexes not strongly dimorphic in wing color; hind wings usually more than 20 mm. in length (Pl. XIV, Fig. 3) ... SYMPETRINI, p. 261

Subfamily CORDULINAE Selys

The nymphs are closely allied to the Libellulinae, being separable largely by the longer lateral and terminal appendages. Some genera are more easily recognized by the presence of a frontal horn on the head.

The adults are also closely related to the Libellulinae, from which they may be distinguished by tubercular or ear-shaped projections on the side of segment 2 of the male abdomen and the small lobe on the caudal margins of the compound eyes. The lobe of the compound eyes, however, is also present quite noticeably in some of the Libellulinae and does not offer a clear-cut distinction in all cases. The mesopleural suture (Fig. 40) does not have the double curve of the Libellulinae, but even this character must be used with care since there is some variation and not all species are exactly similar to the figures. In the Cordulinae, in order to see the suture, the surface hairs of the thorax must be scraped away. The whole subfamily intergrades with the Libellulinae, and persons not acquainted with the subfamilies often confuse them.

For literature see:

Martin, Rene. Collections Zoologiques Edm. de Selys Longchamps, Fasc. XVII, 89 pages, 3 plates: 1906.

Needham, J. G. Annals of the Entomological Society of America, 1: 273-280: 1908.

Williamson, E. B. Entomological News, 19: 428-434: 1908.

Tribe MACROMIINI Tillyard

The nymphs of this group may be separated from all others by the presence of a prominent horn on the front of the head. The adults are strong, active fliers, resembling *Cordulegaster* in coloration. The triangle of the hind wings is distad of the arculus.

Key to Genera

Nymphs

1. Head hardly as wide across the eyes as across the hind angles; lateral spines of the ninth abdominal segment hardly surpassed by the tips of the terminal appendages (Pl. iv, Fig. 5) **Didymops, p. 202**
- Head widest across the eyes; spines of the ninth abdominal segment not reaching the apices of the terminal appendages, usually not longer than segment 10 **Macromia, p. 204**

Adults

1. Eyes contiguous but meeting in a single point only; margin of hind wings between nodus and stigma more than half the length between stigma and the base of the wing (Fig. 41) **Didymops, p. 202**
- Eyes distinctly contiguous, meeting in a mesal line of considerable length; margin of hind wings between nodus and stigma less than half its length between base of the wing and the stigma (Pl. xi, Fig. 1) **Macromia, p. 204**

Genus *Didymops* Rambur

Nymphs.—With frontal horns; hind angles of head obtusely rounded, not angulate; mental setae seven, five lateral setae; abdomen with dorsal hooks; lateral spines of segment 9 as long as that segment.

Adults.—With arculus sectors united for some distance beyond arculus; triangle free; subtriangle present, the cubito-anals usually three in number; area between M_4 and Cu_1 widened at margin of front wing; base of the wings infuscated; eyes contiguous in a single point only; no elongate forked process on segment 8 in the female; abdomen gradually contracted behind the second segment and strongly compressed; color not metallic, usually dull.

Didymops transversa (Say)

Journal of the Academy of Natural Sciences of Philadelphia, 8: 19: 1893.

Nymph (Pl. iv, Fig. 5).—Color dark and light brown.

Head: labium extending between the middle and hind coxae, mentum a trifle longer than broad, conspicuously contracted at base, with 5 to 6 long setae on each side, and a number of smaller ones between the two series; distal margin of the mentum spinose; labial palpi (Fig. 7, No. 9) with 6 teeth on mesal margin, the teeth with minutely crenulate margins and 3-4 unequal long spines at their apices; 5 lateral setae on each palpus and an additional one near the lateral articulation, the dorsal margins also with a row of smaller setae; labrum setose below; antennae 7-segmented, segments 1 and 2 thicker; 3-7 subequal in length, a single prominent frontal horn between the antennae, the horn provided with a few long setae, and densely spinose, with minute spines above; caudo-lateral margins of the head with blunt tubercles.

Thorax: legs spotted, the femora with three dark bands, and small spots between; tibiae spotted, the hind femora mostly brown; tarsi and claws brown; hind femora when extended parallel to the body reaching the caudal margin of abdominal segment 9; pronotum with a curved caudal ridge connected with lateral prominences; a single rather broad, triangular plate over the procoxae projecting cephalad; wing-pads (immature specimen) extending beyond the base of abdominal segment 6.

Abdomen: broad, flat below (almost circular in ventral view) the dorsal surface mottled with brown; lateral keels with spines on segments 8 and 9, those on 9 extending slightly beyond the tips of the appendages (equal or very slightly shorter in some); prominent dorsal hooks present on segments 2-9, those on 6-7 largest; terminal appendages subequal in length, the ventrals slightly longer.

Measurements: total length, 25 mm.; length of abdomen, 15 mm.; greatest width, 12 mm.; length of hind femora, 11 mm.; length median lobe, 6 mm.; width, 2-6 mm.

Described from a nearly mature nymph obtained at Mt. Carmel, Conn., October 29, 1921; taken from a small woodland pond.

Two smaller nymphs obtained at the same place and date differ in having shorter lateral spines on abdominal segment 9 (not reaching the tips of the terminal appendages) and fewer mental setae (5 in number). Measurements of these nymphs are as follows: total length, 12 mm.; length of abdomen, 7 mm.; width, 5.5 mm.; length of hind femora, 6 mm.; length of metathoracic wing-pads, 1 mm.

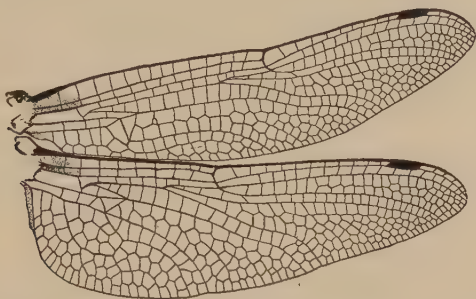


FIG. 41. Wings of *Didymops transversa*, tracing from photograph, $\times 1.7$.

Adult, male.—Color grayish to brown.

Head: brown to buff, the front with a T-spot and a conspicuous depression above; compound eyes contiguous.

Thorax: brown, with buff spots on the mesokatepisterna and paraptera of the front wings, and a conspicuous buff or whitish stripe, about 1 mm. in width, extending from between the wings to a point between meso- and metacoxae; legs brown, except the tarsi, which are nearly black; tarsal claw with ventral tooth nearly at tip, the tooth nearly as long as the portion of the claw beyond it; wings (Fig. 41) with brown or yellowish veins, and an infuscation at base; anal loop nearly oval.

Abdomen: strongly compressed beyond the third segment; terga 2-8 with yellow spots on each side at base, those on 8 united on the meson; segment 10 entirely yellow.

Female.—Similar to the male; vulvar lamina short, widely separated, and about one-sixth as long as the segment.

Measurements: total length, male 52, female 55 mm.; length of abdomen, male 35, female 31 mm.; length of hind wings, male 34, female 35 mm.; length of stigma, male and female, 2-2.5 mm.

Connecticut.—Mt. Carmel, 6 June, 1908 (B. H. W.); Southington, 16 June, 1926 (M. P. Z.); Litchfield, 6 June, 1925 (L. B. W.).

New England.—May-August.

Genus *Macromia* Rambur

Nymphs.—With prominent frontal horns; teeth on proximal segments of the labial palpi with deep incisions between them; spines of the ninth abdominal segments not reaching to the apices of the terminal segments.

Adults.—With sectors of the arculus united for some distance beyond the latter; triangle free or with one cross-vein; subtriangle present, the cubito-anal cross-veins usually three in number; area between M_4 and Cu_1 in front wings not widened apically; no dark spots on wings; eyes meeting in a line of considerable length; abdomen of female without a long forked process on sternum of segment 8; abdomen of female and male slightly compressed.

For literature dealing with *Macromia* adults, see
Williamson, E. B. Proceedings U. S. National Museum, 37: 369-398:
1907, pls. 35-36.

Key to Species

Males and Females

Dorsum of thorax without yellow marks; average length of abdomen 49 mm. (47-52 mm.)	<i>illinoiensis</i>
Dorsum of thorax with distinct yellow marks; average length of abdomen 59 mm. (56-61 mm.)	<i>taeniolata</i>

Macromia taeniolata Rambur

Histoire naturelle des insectes. Neuroptères, 139: 1842.

Adult, male.—Color black and yellow.

Head: with pale transverse band just above the clypeus; occiput black.

Thorax: with faint stripes on the mesepisternum in front and the usual lateral stripe on the metepisternum; sides of the thorax showing metallic green.

Abdomen: black with transverse interrupted band on segment 2; triangles on 3 to 7 inclusive and basal spots on segment 8 pale; triangles on 7 united, forming a transverse band; anal appendages in dorsal view show the superiors with a slight tubercle near middle; tips pointed in lateral profile, bases yellow.

Measurements: total length, male 75 to 84, female 81 mm.; length of abdomen, male 58, female 56 mm.; hind wings, male 46-52, female 51 mm.; width of hind wings, male 12, female 14 mm.; length of stigma, male and female, about 4 mm.

Specimens examined in the Museum of Comparative Zoology.

Macromia illinoiensis Walsh

Journal of the Academy of Natural Sciences of Philadelphia, 397, 1862.

Nymph.—Color of alcoholic specimens uniform brown or nearly black.

Head: palpi with 6-7 lateral spines and a slender end hook;

teeth as wide as deep, each tooth with long heavy setae, which increase in number from 2 on tooth next the movable hook to 8 or 9 on the tooth next the caudo-mesal angles; margins of each tooth crenulate; distal margins of mentum spinulose; mental setae 7-8 on each side, and a number of minute setae between the two rows of longer ones; head widest across the eyes, the caudo-lateral margins bluntly angulate.

Thorax: legs with long femora and tibia, the tibiae of the hind femora extending to the middle of segment 9 or beyond; tarsal segments composed of one short and two long segments.

Abdomen: with prominent dorsal hooks on middle of segment 2-9 inclusive, and lateral spines on segments 8 and 9, that on 9 about as long as segment 10; lateral terminal appendages three-fourths as long as the ventrals.

Measurements; immature nymph: total length, 17 mm.; abdomen, 10 mm.; hind femora, 7 mm.; wing cases, 1 mm.

Two immature specimens received from Kentucky; others examined in Cambridge Museum of Comparative Zoology.

Adult, male.—Color black and yellow.

Head: labium, labrum and clypeus pale; front brown with a yellow spot or two spots on each side; vertex and occiput dark brown.

Thorax: dorsum without yellow, each side with a yellow stripe on metepisterna from legs to wing bases and about 1 mm. wide; legs black or dark brown, the distal half of front and middle femora with a prominent carina beneath; wings (Pl. XI, Fig. 1) usually clear, triangles usually with cross-veins (sometimes free).

Abdomen: black and yellow; tergum 2 with a yellow transverse band interrupted on the meson and at the auricles; terga 3 and 4 each with 2 yellow triangles, the caudal margins of which are in contact with the median transverse carinae; spots also present on 5 and 6; tergum 7 with a transverse yellow basal band, from cephalic margin to the transverse carina, the yellow not reaching the lateral margins and extending a trifle along the dorsal carina; tergum 8 with a pale triangle at base; terga 9 and 10 black; anal appendages black; viewed from above, the superiors are lyre-shaped; viewed from the side, the superiors are seen to possess a carina which extends slightly beyond the middle; beyond the tip of the carina the superiors are denticulate beneath; inferior appendage slightly longer than the superiors.

Female.—Similar to the male; abdominal spots larger.

Measurements: total length, male 61-66, female 65-72 mm.; length of abdomen, male 44-46, female 51 mm.; length of hind wings, male 40-42, female 46-47 mm.; width of hind wings, male 11, female 13 mm.

New England.—Recorded by Howe from Maine, Massachusetts, New Hampshire and Rhode Island, June 16-August 16, but not yet collected in Connecticut.

Tribe EUCORDULIINI Tillyard

Nymphs without frontal horns; tip of abdomen consisting of long segments, except the tenth, which is short. Adults have the triangle of the hind wing not distad of the arculus, the proximal side about on a line with the latter.

*Key to Genera***Nymphs**

1. Lateral spines of segment 9 as long as, or longer than the terminals; teeth of palpi or lateral lobes as long as wide (except in *Tetragoneuria*) 2
 - Lateral spines of segment 9 not reaching the ends of the terminals; teeth of palpi or lateral lobes much shorter than wide 4
2. Lateral spines of segment 8 set at an angle to the long axis of the abdomen (Pl. iv, Fig. 6), not parallel to those of segment 9 ... **Neurocordulia**
 - Lateral spines of segment 8 not set at an angle, and parallel to those of segment 9 3
3. Lateral setae four or five; length, full grown 27 mm. ... **Epicordulia**
 - Lateral setae seven; length, full grown about 16 mm. ... **Tetragoneuria**
4. Dorsal spines or prominences absent **Cordulia**; **Somatochlora**
 - Dorsal spines or prominences present, the elevations hook-like in some genera 5
5. Dorsal spines or hooks present on segments 3 or 4 **Somatochlora**
 - Dorsal spines or hooks absent on 3 and 4 6
6. Dorsal hooks or prominences on 6-9 inclusive, those on 7-9 long, hook-like; lateral spines on 9 reaching the tips of the terminal appendages **Helocordulia**
 - Dorsal hooks or prominences on 5 to 8 or 9, those on 7-9 not long or hook-like; lateral spines on 9 not reaching the tips of the terminal appendages **Dorocordulia**

Adults

1. Front wings with the area between M_4 and Cu_1 enlarged at the distal end so that the rows of cells are greatly increased towards the margin of the wing (Pl. x, Fig. 4) 2
 - Front wings with the area between M_4 and Cu_1 not enlarged at the distal end so that the rows of cells are greatly increased towards the margin, but of nearly equal width throughout 3
2. Triangle with cross-veins (Pl. x, Fig. 4) **Neurocordulia**
 - Triangle without cross-veins (Pl. xvi, Fig. 1) **Williamsonia**
3. Two cubito-anal cross-veins present in the hind wings; antenodals never infuscated (Pl. xiv, Fig. 4) **Somatochlora**
 - Only a single cubito-anal cross-vein in the hind wings; or if with two, then some of the antenodals infuscated 4
4. Triangles of the front wings without cross-veins (Pl. x, Fig. 3) **Dorocordulia**
 - Triangles of the front wings with cross-veins 5
5. Wings without black basal marks (Pl. xi, Fig. 2) **Cordulia**
 - Either front or hind wings with black basal marks 6
6. Triangles of the hind wings with cross-veins; wings with black spots at nodus and tip (Pl. xiv, Fig. 2) **Epicordulia**
 - Triangles of the hind wings without cross-veins; wings without black spots at nodus and tip 7

7. Abdomen large, segments 3 and 4 of male flattened beneath; 4 to 5 antenodals in the hind wings (Pl. XII, Fig. 1)...**Tetragoneuria**
 Abdomen small, slender, rounded; 5 to 6 antenodals in the hind wings (Pl. XII, Fig. 4)**Helocordulia**

Genus *Epicordulia* Selys

Nymphs.—Caudo-lateral margins of the head angular, palpal (or lateral) setae 4 or 5, dorsal hooks on abdominal segments 2 to 9; lateral spines of segment 9 surpassing the tips of the terminal appendages.

Adults.—Sectors of arcus separated at point of union; triangle with cross-veins; subtriangle absent, there being only one cubito-anal cross-vein; area between Cu_1 and M_4 not widened at margin of front wing; dark spots at base, nodus and apex of wing; abdomen of female with a forked process on venter of segment 8; considerable contraction behind segment 2, but the abdomen depressed, not compressed; color not metallic.

The nymphs are reported to inhabit the bottoms of ponds, crawling over dead wood or stones. The adult is a particularly strong flier and the eggs are laid while in flight by dipping the tip of the abdomen in the water.

Epicordulia princeps Selys

Synopsis of the Neuroptera of North America, 134: 1861.

Nymph (Pl. IV, Fig. 8).—

Head: caudo-lateral margins rounded, with a small tubercle on each side behind the mesal angles of the compound eyes; labium with 5 lateral setae on the palpi (an additional smaller one at base of movable spine), and 4 mental setae each side, the interior surface heavily setose near the distal margin.

Thorax: sides dark with a lighter stripe above the coxae; hind femora extending to segment 7, wing-cases to middle of segment 5.

Abdomen: broad, flat beneath, with two longitudinal grooves dividing the surface into thirds; prominent dorsal hooks on segments 2-9 inclusive, and lateral spines on segments 8 and 9, those on 9 exceeding the terminals in length.

Measurements; exuviae: total length, 27 mm.; length of abdomen, 14-15 mm.; greatest width of abdomen, 11-12 mm.; length of hind femora, 7-8 mm.

Adult, male.—Color black and dark brown or olive.

Head: brown, labium buff.

Thorax: brown, somewhat darker on the shoulder of the mesepimera; wings (Pl. XIV, Fig. 2), large dark brown spots on base, nodus and apex; triangle of the hind wing with a cross-vein; anal loop, foot-like; legs with brown coxae, trochanters, and femora; tibiae and tarsi black.

Abdomen: segments 2 and 3 swollen and lighter in color than

the distal members; segments 2-9 with black, minutely serrate, longitudinal, lateral keels, the terga somewhat lighter on the sides.

Female.—A forked process on the venter of 9, the process projecting to the tip of that segment; superior anal appendages longer than segment 9 plus 10 (6 mm.).

Measurements: total length, male 62-64, female 62-68 mm.; length of abdomen, female 45 mm.; length of hind wing, male 40, female 43-45 mm.; length of stigma, male and female, 3-4 mm.

Connecticut.—Guilford, 27 July, 1920 (M. P. Z.), 8 July, 1921 (P. G.); East Haven, 4 July, 1921 (P. G.); Wallingford, 13 August, 1922 (S. W. B.).

New England.—May 25-August 27.

Genus *Helocordulia* Needham

Nymphs.—Hind margins of the head rounded; mental setae 12-14, palpal setae 6 or 7; dorsal hooks present on abdominal segments 6-9, lateral spines of segment 9 extending to the tip of the terminal appendages.

Adults.—Sectors of arculus separated at point of union with the latter; triangle of front wings usually with cross-veins, sub-triangle usually absent in hind wings, there being only one cubito-anal cross-vein; area between Cu_1 and M_4 not widened at margin of front wing; dark spots at base and along costal margins; abdomen of female without long forked process on venter of 8; segment 3 of abdomen compressed.

Not much is known of the habits of this genus, but the adults are day-fliers, not crepuscular.

Helocordulia uhleri (Selys)

Bulletin de l'Academie royale . . . de Belgique (2), 31: 274: 1871.

Nymph.—Labium with strongly projecting median lobe; mental setae 12 to 13 on each side, those nearest the mesal line very minute; setae of the labial palpi 6 to 7, the movable hook on distal segment little larger than the setae; spines of the teeth about 4 in number on each.

Abdomen²⁴: dorsal hooks on segments 6 to 9 inclusive; mere rudiments in front of this; lateral spines on segments 7 to 9, those on 9 about one-third as long as that segment. Lateral spines on segment 9 approximately as long as the dorsum of that segment.

Measurements: total length, 20 mm.; length of abdomen, 11 mm.; width, 6 mm.; length of hind femora, 6-6.5 mm.

Adult, male.—Color dark brown and black.

Head: face including labium, clypeus, genae and front, yellow or brown, the dorsal surface of the front much depressed in the center and blackish brown in the depression; occiput and post-genae brown.

²⁴ From Needham, J. G., Bull. N. Y. State Museum 47: 408.

Thorax: brown or metallic green or blue, with white hairs; legs black, the femora with short spinules; spines of the tibiae much longer; tarsi and claws black; wings (Pl. XII, Fig. 4) clear, the fore wings with dark basal spots covering the first two (sometimes more) of the antenodal cross-veins; hind wings with similar spots, and also spots in the 2-celled anal triangle.

Abdomen: black with brown on sides and dorsum of 1; cephalic portion of 2 below the auricles, basal third of 3, and cephalo-lateral angles 4 to 8 inclusive pale; 9 and 10 mostly black; lateral carinae present on segments 4 to 9 inclusive, absent on 1-3; anal appendages black, the superiors in lateral profile, bluntly pointed, almost truncate, with a faint indication of a submedian inferior tooth; inferior appendage three-fourths as long as the superiors; viewed from below, the inferior is about three-fifths as broad at apex as at base, and has a blunt apical tooth on each side, the apical margin being shallowly concave.

Female.—Similar to the male.

Anal appendages black; vulvar lamina a little shorter than segment 9, divided into two pointed plates by a median incision, their lateral margins with minute teeth; segments 3, 4, and 5 not constricted as in the male, and spots on cephalo-lateral angles larger.

Measurements: total length, male 46, female 41 mm.; length of abdomen, male 29-31, female 28 mm.; length of hind wings, male 28, female 27-28 mm.; width of hind wings, male 8.5, female 8.5 mm.

Connecticut.—Woodbridge, 20 May, 1923 (W. E. B.); Litchfield, 31 May, 1915, 17 June, 1924, 6 June, 1925 (L. B. W.); Storrs, 1925, C. B. Brink.

New England.—May 15-July 12.

Genus *Tetragoneuria* Hagen

Nymphs.—Without frontal horn; the hind angles of the head rounded; mental setae 6 to 9, palpal or lateral setae 7; dorsum of abdomen with hooks on 2-9; lateral spines of segment 9 exceeding the terminal appendages.

Adults.—Arculus sectors separated from point of union with the arculus; triangle of front wings with cross-vein; subtriangle absent, there being only one cubito-anal cross-vein; area between M_4 and Cu_1 not expanded at margin of front wing; bases of hind wings dark; compound eyes meeting in a short line on dorsum; female with a long forked process on venter of segment 8; abdomen not contracted or compressed laterally (except segments 3 and 4 of the female) but for the most part depressed; no metallic green or blue.

For literature on this genus, see

Muttkowski, R. A. Bulletin of the Wisconsin Natural History Society
13: 49-61: 1915.

The nymphs of probably the most common species in Connecticut are very active in late fall and early spring along the edges of ponds and streams, usually in vegetation of some kind. The adults appear very early in summer and often congregate in droves in favorable locations away from the water. A large number of the species *cynosura* were seen at one time about a clump of sumach. On investigation it was found that they were feeding upon a species of Psyllid, *Calophya nigripennis* Riley, which were very abundant on that host. The eggs of some species, at least, are known, and they are reported (Needham 1901) to be laid in strings and draped over vegetation in the water.

*Key to Species*²⁵

Adults, Males

1. Superior anal appendages seen in lateral profile with a sharp submedian inferior tooth **spinigera**
Superior anal appendages without a sharp submedian inferior tooth 2
2. Superior anal appendages with a tubercle above, near tip **canis**
Superiors without a tubercle above near tip 3
3. Front with a dark T-spot above **(morio)**
Front without a dark T-spot above **cynosura**

Females

1. Front with a T-spot above 2
Front without a T-spot above 3
2. Vulvar lamina not 2 mm. long or less **(morio)**
Vulvar lamina 3 mm. long **spinigera**
3. Vulvar lamina less than 2 mm. long **cynosura**
Vulvar lamina usually 3 mm. long **canis**

Tetragoneuria spinigera Say

Bulletin de l'Academie royale . . . de Belgique (2), 31: 269: 1871.

Nymph.—Color of exuviae uniform brown.

Head: labium extending between the procoxae and mesocoxae; mentum with 7-9 setae on each side, the distal margin extended considerably on the meson and forming an obtuse angle, the distal margin thinly spinose; labial palpi with 6 lateral setae, the mesal margins each with 6 rounded teeth about as wide as long, each having 3-4 heavy spines and several smaller ones; labrum with a fringe of hairs on the ventral margin; front and vertex dark brown with a paler T-spot between the antennae; mesal angles of the compound eyes rounded; a small setose elevation on the vertex behind each caudo-mesal angle of the eyes; caudo-lateral margins of the head rounded.

²⁵ *Semiaquaea* differs from the species given in the key in having the wings clouded distad as far as the nodus. Nymphs of the different species are so closely related that no attempt will be made to construct a key for their separation. *Canis* is said to possess much shorter spines on segment 9 than any other species, but this is uncertain since the species has not been reared.

Thorax: pronotum with flaring and rounded margins; a blunt projection above each procoxa; meso- and metapleura with dark mottling and an obscure lateral dark stripe on each side; legs brown, without spines, and with very faint ridges, the front and middle femora showing 2 dark rings, the tibiae of the same with a dark ring at base of each; metathoracic wing-cases extending to caudal margin of segment 4.

Abdomen: brown with obscure mottling, the lateral keels with spines on segments 8 and 9, those on 9 being about 1 mm. in length, those on 8 about .25 mm.; the distance from the tip of the spine to the base of segment 9 measured on the lateral margin, 3-3.5 mm.; dorsal hooks of abdomen consisting of slender ones on segments 1 and 2, which are not greatly thickened at base, and much larger ones on 3-9, the latter thickened, and those on 6-8 largest; anal appendages short, the laterals about half the length of the ventrals, the dorsal appendage slightly shorter than the ventral.

Measurements: total length, 21 mm.; length of abdomen, 11-12 mm.; greatest width, 7 mm.; hind femora, 6.5 mm.; metathoracic wing-cases, 5 mm.; mentum, 3.5 long by 1.5-4 mm. wide.

Described from 3 exuviae collected at Colebrook, June 1920, and one loaned by Dr. P. P. Calvert from New Jersey.

Adult, male.—General color dark brown to black.

Head: brown, buff below; front with a black T-spot, the stem being considerably broader than the cross-arm.

Thorax: brown with gray pile; obscurely marked with black on the shoulders of the mesepimera; coxae, protrochanters and profemora brown, remainder of the legs black; tibiae with the usual ventral ridge and apical scale-like spurs; wings clear except small, separated brown spots at the base of the hind wings, the largest of which occupies about half the anal triangle.

Abdomen: black, the first two segments almost entirely brown; terga 3-8 black, with lateral yellow spots on each side above the lateral carinae; venter of terga 4-8 each about half yellow; segments 9 and 10 entirely black; anal appendages black, the superiors with a sharp ventral tooth, shortly proximad of the middle.

Female.—Similar to the male, but with the black T-spot indistinct; superior anal appendages 1.7-2 mm. in length.

Measurements: total length, male 45, female 43-46 mm.; length of abdomen, male 30, female 29-31 mm.; length of hind wings, male 29, female 31-32 mm.; length of stigma, male and female, 2 mm.

Connecticut.—Represented by two males in the collection of the Connecticut Agricultural Experiment Station taken at Goshen, July 6, 1919, by M. P. Zappe. Also reported from Litchfield by Woodruff; collected in Hamden, May 30, 1922 (P. G.).

New England.—May 19-July 23.

***Tetragoneuria cynosura* (Say)**

Journal of the Academy of Natural Sciences of Philadelphia, 8: 30: 1839.

Nymph (Pl. IV, Fig. 4).—Color brown and black.

Head: labium (Pl. VII, Fig. 3) extending between the meso-coxae, the median lobe about as long as wide; mentum with 9 setae on each side; labial palpi with 8-9 teeth on the mesal margin, each tooth with 5 or 6 spines of different sizes; lateral setae 6; antennae pale, the first two segments darker, segments 3 and 6 subequal in length; a conspicuous black band between the compound eyes, the caudal margin of which follows the opaque portion of the eyes and extends cephalad slightly on the meson; behind the black stripe the surface of the head is spotted with brown, and there is a black line running from each eye to the caudal margin of the head; these lines are continued on the thorax, gradually widening caudad.

Thorax: pronotum with caudal ridge, flaring considerably at the sides; a single broad projection over each procoxa extending towards the head; front and middle femora with two brown rings each, and a trace of black between trochanters and femora; hind femora with a single brown ring; front and middle tibiae faintly ringed with brown; tarsi and hind tibiae brown; hind femora extended parallel to the body reach the middle of abdominal segment 8; wing-cases reaching the middle of abdominal segment 7.

Abdomen: dark brown above, spotted with pale on the sides and with a broad, dark, dorsal band, the margins of which are undulate; lateral keels with a short spine on segment 8, and a longer one on 9 reaching beyond the apices of the terminal appendages (1 to 1.5 mm. long); dorsal hooks present on segments 2-9, slender on 2-6 inclusive, considerably thicker on 7-9; terminal appendages with lateral appendages about half the length of the inferiors, the superior appendages noticeably shorter than the inferiors.

Measurements: total length, 16 mm.; length of abdomen, 8 mm.; greatest width, 7 mm.; length of hind femora, 5 mm.; length of median lobe, 3.5 mm.; width, 2-3.5 mm.

A reared specimen and a number of others in the collection of the Connecticut Agricultural Experiment Station.

***Tetragoneuria cynosura* Say variety *cynosura* Say**

Adult, male (Pl. XIX, b).—Color dark brown to black.

Head: light brown to yellow; front without T-spot.

Thorax: brown with obscure black markings and a yellow spot above and below the metastigma; thickly provided with gray pile; legs with coxae, trochanters and profemora brown, remainder black; tibiae each with a flat ridge beneath, which ends in a flat scale-like spur; wings (Pl. XII, Fig. 1) clear except the base of

the hind wings, where there are usually two well-separated areas of infuscation. This color may reach the base of the triangle but is usually less in extent.

Abdomen: brown to nearly black; the first two segments and half the third entirely brown; terga 3-10, black with longitudinal yellow spots on the sides of 3-9, just above the lateral carinae; venter of terga 3-8 mostly yellow, somewhat darker on the caudo-lateral angles; segments 1 and 2 much thicker than the following segments, which are not at all compressed or narrowed but depressed; anal appendages black, the superiors without ventral or apical teeth; accessory appendages of the second segment as in Fig. 63, No. 13.

Female.—Very similar to the male; tibial ridges absent; segment 2 with a conspicuous yellow spot below; abdominal segments 3-6 compressed; hind wings with almost no pigment at base; vulvar lamina projecting to the middle of the tenth abdominal segment.

Measurements: total length, male 40-43, female 38-40 mm.; length of abdomen, male 27-29, female 25-28 mm.; length of hind wing, male 28-30, female 29-30 mm.; length of stigma, male and female, 1.5-2 mm.

There are two recognized varieties of *T. cynosura*,²⁶ *c. cynosura* Say and *c. simulans* Mutt., which differ only in the extent of the pigment at the base of the hind wings. In *c. simulans* the pigment extends from the base to the tip of the triangle, while in *c. cynosura* the color may reach the base of the triangle but is usually less extensive. The variety *cynosura* is the more common in Connecticut.

Connecticut.—West Thompson, 12 July, 1905 (H. L. V.); New Haven, 10 June, 1906 (B. H. W.); Mount Carmel, 6, 19 June, 1908 (B. H. W.); New London, 6-22 June, 1921 (R. H. H.); Hamden, 22, 27 May, 8 June, 1922 (P. G.); Litchfield, 16 June, 1925, also other dates (L. B. W.).

New England.—April-July.

Tetragoneuria canis McLachlan

Entomologists Monthly Magazine, 23: 104: 1886.

Adult, male.—Color brown, black and yellow.

Head: buff, front without T-spot.

Thorax: brown or olivaceous, with gray pile, and with obscure lateral lines of black; wings with brown spot at base of hind wing occupying somewhat more than half the anal triangle in the specimen at hand.

Abdomen: black, the first two segments olive; terga 2-9 black, with longitudinal yellow spots on each side above the lateral carinae; venter of terga 3-9 mostly yellow, the caudal half or third black; superior anal appendages with a dorsal protuberance three-

²⁶ Muttkowski, R. A. Bull. Wis. Nat. Hist. Soc., 9: 91-134: 1911 and 13: 46-61: 1915.

fourths its length from the base, the ventral surface with a blunt tooth at middle.

Female.—Similar to the male; anal appendages 3 mm. in length.

Measurements: total length, male 40 mm.; length of abdomen, male 30 mm.; length of hind wing, male 29 mm.; length of stigma, male and female, 2.5 mm.

Male described from one specimen in collection of Connecticut Agricultural Experiment Station without locality or place label.

New England.—May 31-July 18.

Genus *Cordulia* Leach

Nymphs.²⁷—Hind angles of the head rounded; mental setae about 14, lateral setae 7; no dorsal hooks (or very rudimentary ones); lateral spines of segment 9 about one-fifth the length of that segment.

Adults.—Sectors of arculus separate to point of union with it; triangle of the front wing with cross-vein; subtriangle absent, there being only one cubito-anal cross-vein; area between Cu_1 and M_4 not widened at margin of front wing; no dark spots in wings; compound eyes contiguous; female without a long forked process on venter of segment 8; both sexes with abdomen contracted behind segment 2 and slightly compressed; color frequently metallic.

Cordulia shurtleffi Scudder

Proceedings of the Boston Society of Natural History, 10: 217: 1866.

Nymph.—Head: brown stripe between the eyes; seven antennal segments, segments 2, 4 and 7 subequal, 1 and 3, and 5 and 6 equal in length, labial palpi with 7 lateral setae, the mesal margins with eight notches, the teeth between each with three spines, a long one, another about half this, and a third very small.

Thorax: femora with two brown rings each; tibiae hairy.

Abdomen: almost free from hairs except the caudal ventral margin of segment 9 and the lateral keels; dorsum dark brown with paler stripe on the meson; lateral spines on segments 8 and 9 very short, not over .25 mm.; terminal appendages 1 mm. long, the laterals more than half the length of the ventral appendages.

Measurements: total length (immature), 19 mm.; length of abdomen, 11 mm.; hind femora, 5.5 mm.; width of abdomen, 6 mm.; length of segment 9 on ventro-meson, 1.75 mm.

Adult, male.—Color brown, black, and metallic green.

Head: labium buff, labrum black, yellow above; clypeus and cephalo-ventral and lateral portions of the front, brown; dorsal part of front and vertex, metallic green; occiput and postgenae black.

²⁷ Apparently indistinguishable from some species of *Somatochlora*.

Thorax: bronze or greenish metallic, the venter dull brown; legs black except the coxae, which are brown; middle and hind femora with a ventral line of short spines from base to apex, the line consisting of three to four spines abreast at base, but reduced to a single one at apex; tibiae with ventral keels as in *Tetragoneuria*, but the latter attached to the apical half of each and never more than half as long as the tibia; thorax with brown pile; wings (Pl. XI, Fig. 2) clear, with only a touch of brown at the extreme base of the hind wings; membrane all dark, the hind wings slightly yellow at base.

Abdomen: black, terga 1 and 2 and part of 3 brown on sides, and a yellowish area on 2 below the auricles; apical three-fourths of the dorsum of the third terga and dorsum of 4 to 10 black; ventral area of 4 to 9 mostly yellow; accessory and anal appendages black; inferior anal appendage bifurcate and each arm cleft at the apex.

Female.—Vulvar lamina about one-third as long as segment 9, truncate, the median notch about half the depth of the plates, the whole very similar to that of *Gomphus descriptus* (Fig. 20, No. 13) but the tips are truncate.

Measurements: total length, male 46-50, female 43-45 mm.; length of abdomen, male 31-32, female 30-37 mm.; length of hind wings, male 29-30, female 30-32 mm.; length of stigma, male and female, 2-2.5 mm.

The doubly bifurcate inferior appendage of the male is characteristic of the species and genus.

Connecticut.—Litchfield, 27 June, 1909, 28 June, 1918 (L. B. W.); Cornwall, 1 June, 1925 (L. B. W.); Hamden, 7 June, 1927 (P. G.).

New England.—May 30-August 11.

Genus *Somatochlora* Selys

Nymphs.—Dorsal projections of segment 4 to 9 flattened, not hook-like, sometimes wanting; lateral spines of segment 9 usually less than half the length of that segment, sometimes lacking altogether; hind margin of segment 9 strongly concave above; conspicuous ventral pubescence on caudal margin of segment 9; no frontal horn.

Adults.—Arculus sectors separated at point of union with the arculus; triangles usually with, but occasionally without cross-veins; subtriangle present, there being usually two cubito-anal cross-veins in the hind wings; area between Cu_1 and M_4 not widened at margin of front wing; no dark spots present on the wings (rarely with spot at base); compound eyes meeting on the dorso-meson; abdomen compressed, or not compressed; color often metallic.

Adults of this genus are very rare in collections. Most of the species are boreal in their distribution and their presence in Con-

necticut when found may be regarded as largely accidental. They are said to be crepuscular or twilight fliers and this apparently holds true for the few that have been collected in this State. According to Walker (1925) there are two types of oviposition, depending on the type of ovipositor. The eggs are laid while the insect is on the wing, however, varying only in the locality in which the eggs are deposited. Such species as *forcipata*, *albicincta* and *cingulata* are said to oviposit in water or wet moss, the act being accomplished by striking the abdomen while in flight. The species *linearis* and *williamsoni* lay their eggs in wet sand, by a similar procedure.

For literature dealing with this genus see—

- Kennedy, C. H. Canadian Entomologist, 49: 229-236: 1917, pl. xiii.
 Walker, E. M. Canadian Entomologist, 50: 365-375: 1918, pl. x.
 ——— University of Toronto Studies Biological series No. 26: 1925; 202 pp., 34 pls. The best and most complete work on this genus in America.
 Williamson, E. B. Entomological News, 20: 77-79: 1909.

In drawing up keys and descriptions of this genus free use has been made of the work of Walker, 1925. The description of nearly all nymphs have been taken direct from that monumental work, though it has been impossible to make use of all the descriptive matter presented therein. The genus *Somatochlora* is divided by Walker into six groups which should be mentioned here, together with the Connecticut species belonging to the different divisions. They are (1) the *metallica* group containing *minor*, *elongata*, *williamsoni*, and *walshii*; (2) the *linearis* group containing *linearis*; (3) the *tenebrosa* group with *tenebrosa*; (4) the *filosa* group with *filosa* and *provocans*; (5) the *arctica* group, containing *franklini*, *kennedyi* and *forcipata*, and (6) the *alpestris* group containing *albicincta* and *cingulata*.

Key to Species²⁸

Nymphs

- | | |
|--|--------------------|
| 1. Dorsal hooks present | 2 |
| Dorsal hooks absent | 6 |
| 2. Dorsal hooks falciform, acute, the last one projecting beyond the middle of segment 10 | 3 |
| Dorsal hooks low knobs, not falciform, the last one not projecting to middle of segment 10 | <i>williamsoni</i> |
| 3. Median appendage of male flat above, the ante-apical tubercle (apex of developing inferior appendages of adult) not at all elevated | 4 |
| Median appendage of male longitudinally concave, the ante-apical tubercle slightly elevated | <i>tenebrosa</i> |
| 4. Lateral spines at least half as broad as long; lateral appendages shorter than segments 9 and 10 together; median appendage not acuminate | <i>linearis</i> |
| Lateral spines less than half as broad as long; lateral appendages as long as segments 9 and 10 together; median appendage acuminate with a very slender tip | 5 |

²⁸ Adapted from Walker, 1925. Species in parenthesis are not described in this paper.

5. Hind femora 6.75 to 7 mm.; hind tibiae 8 mm.; lateral spines on 9 one-third the length of the margin of this segment **minor**
Hind femora 8 mm.; hind tibiae 9 mm.; lateral spines on 9 one-sixth the length of the margin of this segment **elongata**
6. Labium extending laterally over inner margins of the eyes; lateral appendages of male with outer margin not regularly arcuate, more or less sinuate; lateral spines, when present, on both segments 8 and 9 7
Labium extending laterally not quite to the inner edge of the eyes; lateral appendages of male with outer margin regularly arcuate; lateral spines when present confined to segment 9 9
7. Length under 25 mm.; hind femora less than 7 mm.; abdomen without median dorsal prominences; median appendages of male without lateral knobs; coloration uniform 8
Length over 25 mm.; hind femora over 7 mm.; abdomen with median series of slightly elevated prominences; median appendages of male with a distinct knob on each side (developing furcate apex of inferior appendages); coloration not uniform **cingulata**
8. Lateral spines minute, those of segment 9 one-twelfth to one-sixth of the remaining length of the segment (**hudsonica**)
Lateral spines longer, those of segment 9 one-fifth to one-third the remaining length of the segment margin **albicincta**
9. Fringe of hairs on hind margins of abdomen; tergites not forming dorso-lateral tufts; lateral spines on segment 9 normally present; lateral setae (labial palpi) 7 or 8 10
Fringe of hairs on hind margins of abdomen; tergites 6 to 9 forming conspicuous dorso-lateral tufts; lateral spines on segment 9 absent or represented by very minute denticles; lateral setae 9 or 10 **forcipata**
10. Fringe of hair on middle section of hind margins of abdominal tergites 7 and 8 not forming a thick tuft **kennedyi**
Fringe of hair on hind margins of tergites 8 and 9 not forming a median tuft, the hair as long as the median length of the segment (**franklini**)

Adults, Males

1. Tips of the superior anal appendages in lateral profile bent sharply downward at their distal third (Fig. 53) **tenebrosa**
Tips of the anal appendages not bent downwards at distal third; if bent down, then much beyond this point 2
2. Superior anal appendages in dorsal view considerably swollen before tips and with a dense brush of hairs (Fig. 47) **walshii**
Superior anal appendage in dorsal view not swollen noticeably and without a dense brush of hairs 3
3. Superior anal appendages in lateral profile with subapical inferior tooth (Fig. 51) **linearis**
Superior anal appendages not with a subapical inferior tooth 4
4. Extreme tips of superior anal appendages hooked in dorsal view, the appendages turning out at tips (extreme tips hooked and turned in) (**filosa**)
Extreme tip of the superiors not hooked in dorsal view, the appendages not turning out at tips 5
5. Abdomen with white basal rings on the segments; apical third of the superiors bent abruptly mesad in dorsal view 6
Abdomen without white basal rings on the segments; apical third of the superiors not bent abruptly mesad 7

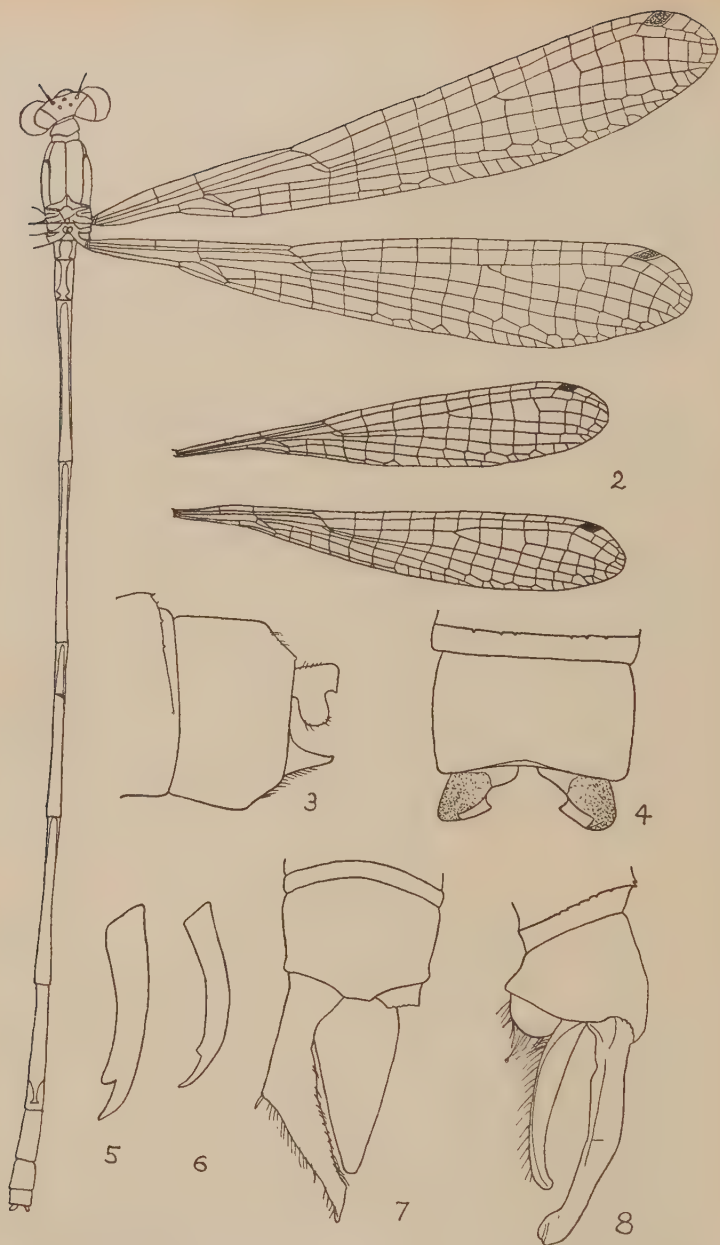


FIG. 42. Structural details of *Telagrion*, *Teleallagma daeckii* and *Somatochlora provocans*. 1. *Teleallagma daeckii*, outline of body and wing veins. 2. Wings of *Telagrion longum* Selys. 3, 4. Anal appendages of *Teleallagma daeckii*. 5. Third tarsal claw of same. 6. Third tarsal claw of *T. longum*. 7, 8. Anal appendages of *Somatochlora provocans* in dorsal and lateral view. (From Calvert, Ent. News 14; pl. 3; 1903.)

6. Inferior anal appendage broader at tip than at base and triangular; basal tooth of the superiors visible from above (Fig. 62)...*cingulata*
Inferior anal appendage not broader at tip than at base; basal tooth of the superiors not visible from above (Fig. 60)...*albicincta*
7. Superiors each with a prominent lateral angle in dorsal view (Fig. 42, Nos. 7 and 8)(*provocans*)
Superiors without a prominent lateral angle in dorsal view 8
8. Superior anal appendages in lateral profile curving upwards at tip, and not decidedly forcipate when viewed from above 9
Superior anal appendages in lateral profile not curving upwards at tip, in dorsal profile decidedly forcipate 11
9. Inferior anal appendage three-fourths as long as the superiors, Fig. 46*minor*
Inferior anal appendage hardly more than half as long as the superiors, Fig. 44 10
10. Superiors parallel distally, with a sub-basal ventro-internal tooth*elongata*
Superiors approximated distally without a sub-basal ventro-internal tooth, Fig. 49*williamsoni*
11. Abdominal segments 5 to 7 with yellow latero-basal spots, greatest width of abdomen at distal end of segment 5, thence narrowing caudad 12
Abdominal segments 5 to 7 without yellow basal spots; greatest width of abdomen at caudal margin of segment 6 or beyond 13
12. Superior anal appendages in profile nearly straight(*incurvata*)
Superior appendages, in profile, arcuate with a very prominent ventro-lateral tooth (Fig. 55)*forcipata*
13. Hind wing a trifle shorter than the abdomen (30:33); anal triangle more or less yellow (Fig. 58)*kennedyi*
Hind wing much shorter than the abdomen (26:38); anal triangle with a brown spot (Fig. 57)(*franklini*)

Females²⁹

1. Vulvar lamina notched apically, or bilobed 2
Vulvar lamina entire at apex 3
2. Vulvar lamina nearly half as long as sternum of 9; deeply emarginate or bilobed*albicincta*
Vulvar lamina one-third as long as sternum of 9; obtusely excavated but scarcely bilobed*cingulata*
3. Vulvar lamina viewed from the side at least four times as long as its basal breadth; usually extending well beyond the caudal margin of segment 10 4
Vulvar lamina less than 4 times as long as its basal breadth and not extending beyond the caudal margin of segment 10 in lateral profile 5
4. Vulvar lamina longer than the appendages(*provocans*)
Vulvar lamina shorter than the appendages(*filosa*)
5. Vulvar lamina erect or suberect, extending ventrad a distance equal to the height of segment 9 in lateral profile, the hind margin nearly at right angles to the ventral margin of that segment ... 6
Vulvar lamina inclined, not erect or suberect, and not extending ventrad a distance equal to the height of segment 9 in lateral profile and the hind margin not at right angles to the ventral margin of that segment 10
6. Labrum at least partly yellow, postclypeus wholly yellow 7
Labrum wholly black, postclypeus or its median part black 8

²⁹ This key has been adapted to Connecticut species from Walker, 1925. Species in parentheses are not described in the text.

7. Lateral thoracic spots present, usually distinct; vulvar lamina longer than segment 9; depth of 9 greater than its length or nearly equal **tenebrosa**
Lateral thoracic spots absent; vulvar lamina about as long as 9; depth of 9 less than its length **linearis**
8. Abdomen less than 35 mm. long; both lateral thoracic spots ovate, clear yellow; vulvar lamina about as long as appendages **minor**
Abdomen more than 35 mm. long; mesepimeral spot elongate; vulvar lamina shorter than the appendages 9
9. Yellow marks of thorax and base of abdomen clear and well defined; no yellow spots posterior to segment 3; vulvar lamina bluntly pointed, not tapering and little compressed **elongata**
Yellow markings of thorax and base of abdomen dull and inconspicuous except in very young individuals; yellow basal lateral spots on segments 5 to 7 or 8; vulvar lamina slender, pointed, somewhat tapering and strongly compressed **williamsoni**
10. Thorax with two lateral yellow spots and yellow spots on abdominal segments 5 to 7 or 8; vulvar lamina as long as sternum of 9 or longer 11
Thorax with only the mesepimeral spot present, sometimes obscure; no yellow spots on abdominal segments posterior to segment 3; vulvar lamina a little shorter than the sternum of 9 13
11. Abdomen about as long as hind wings or slightly shorter; mesepimeral spot elongate; posterior spots subovate; vulvar lamina in natural position, declined, largely black **walshii**
Abdomen slightly longer than the hind wings; vulvar lamina in natural position horizontal, yellowish 12
12. Lateral thoracic spots pale yellow, ovate, fairly well defined; vulvar lamina about as long as sternum of 9 or a little longer... **forcipata**
Lateral thoracic spots ochraceous, obscure or ill-defined; mesepimeral spot elongate; vulvar lamina longer than sternum of 9 (**incurvata**)
13. With 6 to 9 cells between M_1 and M_{1a} ; hind wings with a brown spot at base, sometimes suffused over the entire area; lateral lobes of post-clypeus black, mesepimeral spots usually distinct; appendages scarcely longer than the vulvar lamina (**franklini**)
With 11 to 20 cells between M_1 and M_{1a} ; hind wings more or less yellow at base but without a distinct spot; lateral lobes of post-clypeus brown; mesepimeral spot obscure; appendages nearly twice as long as vulvar lamina **kennedyi**

Group 1. The METALLICA Group

Somatochlora elongata (Scudder)

Proceedings of the Boston Society of Natural History, 10: 218: 1866.

Nymph (Fig. 43).—Labium reaching base of the mesosternum; palpi with 9 crenulations, the two apical ones small and close together, their setae as in *minor*; lateral setae of the palpi 6-7; mental setae 11-12, the fourth and sixth from the outside longest, the first 8 longer and closer together.

Hind wing cases extending to the middle of segment 6.

Abdomen: broadest at sixth segment; dorsal hooks on segments 4 to 9, that of 4 about one-third the length of the segment; that of 5 one-half the corresponding length, the remainder about as long as the segments bearing them; lateral spines of 8 and 9

not divergent, those on 8 scarcely one-seventh as long as the lateral margin of the segment, the basal width scarcely half the length, those on 9 about one-sixth as long as the corresponding segment margin, which is convexly arcuate at base and barely concave beyond middle; lateral appendages one-half shorter than segments 9 and 10 together and about the same length as the median appendage.

Measurements: length, 23-23.4 mm.; width of abdomen, 8-9.25 mm.; length of hind femora, 8 mm.

Adult, male.—Color metallic green and black.

Thorax: yellow marks on the sides, usually a spot and a stripe.

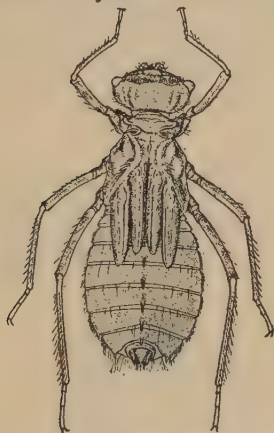


FIG. 43. Nymph of *Somatochlora elongata*, x 1.7. (From Walker.)

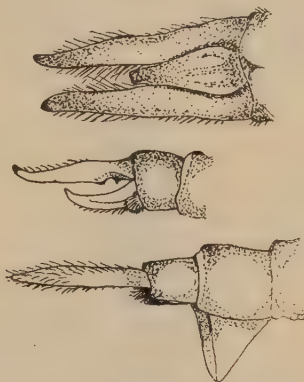


FIG. 44. *Somatochlora elongata* anal appendages of adult. (From Howe.)

Abdomen: entirely black without pale rings or spots; anal appendages (Fig. 44) almost straight, not bent downwards or forcipate or with sharp lateral angles; tips slightly upturned but not recurved.

Female.—Vulvar lamina viewed from the side not extending ventrad a distance equal to the height of segment 9, the appendage entire, its length at base more than half the length of segment 9.

Measurements: total length, male 58, female 56 mm.; length of abdomen, male 39, female 40 mm.; length of hind wings, male 37, female 36 mm.; width of hind wings, male and female, 11 to 11.5 mm.

Specimens examined in the Museum of Comparative Zoology.

Measurements according to Walker as follows: total length, male 52-55.5, female 58-62 mm.; length of abdomen, male 37-39, female 40-43 mm.; length of hind wing, male 34-37, female 35.5-38 mm.; width of hind wing, male 9.4-10.5, female 10.5-11.25 mm.

New England.—July 8-August 12.

Somatochlora minor (Calvert)

Entomological News, 9: 87: 1898.

Nymph (Fig. 45).—Mentum reaching base of mesothorax, mental setae 11 to 13, the outer 7 or 8 much closer together than the others; lateral setae of the palpi 6 to 8; crenulations each with groups of 5 to 6 setae each; hind wing cases reaching the middle of segment 6.

Lateral spines on segment 8 one-fourth as long as the margin of the segment, scarcely divergent, those on 9 about one-third as long as the margin of this segment; dorsal hooks present on segments 4 to 9, compressed, slender and decidedly curved, the hook of 7, 8, and 9 about the same size and about as long as the corresponding segments; dorsal margin of the superior median appendage straight in lateral profile.

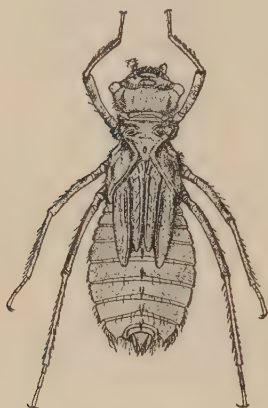


FIG. 45. Nymph of *Somatochlora minor*, x 1.7. (From Walker.)

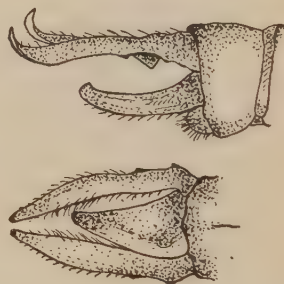


FIG. 46. *Somatochlora minor*, anal appendages of adult. (From Howe.)

Measurements: length, 20.1-22.5 mm.; width of abdomen, 8-9 mm.; hind femora, 6.75-7 mm.

Adult, male.—Color metallic greenish blue, and black marked with yellow.

Head: labium, anteclypeus, and sides of the front below, yellow; labrum black, front, except the yellow spots on sides, metallic green; occiput and postgenae black.

Thorax: pronotum dark brown with pale caudal lobe; meso- and metathorax green with yellow oval spots on mes- and metepimera; venter of thorax brown; legs black, except the coxae and proximal half of the front femora, which are brown; wings a little smoky, the anal triangle surrounded with denser chlorination.

Abdomen: black, with two yellow spots on each side of segment 2 near the auricles, and one on each side of the dorso-meson of the same segment; base of 3 with the yellow more or less divided into dorsal and lateral spots each side; anal appendages (Fig. 46) with a distinct basal tooth, and lateral ridge, in lateral view, the tips tapering to a slightly upturned apex.

Female.—Differing somewhat in color, there being only one spot on the sides of abdominal segment 2; ovipositor almost at right angles to the axis of the abdomen and as long or longer than the vertical diameter of segment 9.

Measurements: total length, male 42-44, female 44-50 mm.; length of abdomen, male 26.5-31, female 31-33 mm.; length of hind wings, male 30.5-33, female 32-34 mm.; width of hind wings, male 8.5-9, female 10-10.4 mm.

New England.—June 22-July 8.

Somatochlora walshii (Scudder)

Proceedings Boston Society Natural History, 10: 217: 1866.

Nymph.—Unknown.

Adult, male.—Color black and metallic green with yellow markings.



FIG. 47. *Somatochlora walshii*, anal appendages of adult. (From Howe.)

Head: labium brown to pale, labrum nearly black, clypeus brown, the front also brown, with a large greenish metallic spot above, vertex and occiput dark brown to black; rear of head black.

Thorax: metallic green varied with reddish brown, with two yellow spots on the sides, the anterior spot in the form of a short stripe, the caudal one oval; legs black, the coxae brown. Wings clear, with 7 ante- and 6-7 postnodal cross-veins in the front wing.

Abdomen: black, swollen at base, narrowed at the third segment, again enlarged from the 5th to 8th or 9th; the lateral margins of segments 2 and base of margin of 3 yellow; 2 and 3 also with dorso-lateral yellow spots, and small obscure spots on the cephalo-lateral angles of 5-7, lateral margin of 8, a small spot on sides of 9, and caudal half or third of the dorsum of 10 yellow; anal appendages (Fig. 47) in dorsal view much enlarged near apices and densely pilose, the lateral surfaces showing two small

teeth at base; the small lateral teeth show more plainly in lateral view; tips of superiors upturned.

Measurements: total length, male 46 mm.; length of abdomen, 29 mm.; length of hind wings, 33 mm.; width, 9.5 mm.

Connecticut.—A male taken at Breakneck Pond, Union, 24 June, 1921, by Mr. S. W. Bromley, belongs here.

New England.—June-September.

Somatochlora williamsoni Walker

Canadian Entomologist, 39: 69-74: 1907, pl. II, figs. 1-1, c.

Nymph (Fig. 48).—Uniform dark to light brown.

Head: hinge of labium reaching middle coxae; mentum about as broad as long, somewhat constricted at about the basal fifth, and again at the apical fourth. Crenulations of the lateral lobes broadly and regularly arcuate, the larger ones with a group of about seven setae, the longest, usually the second or third from the lower end, about as long as the crenulation. Mental setae 11 or 12, the fourth or fifth from the outer end longest; lateral setae 8.

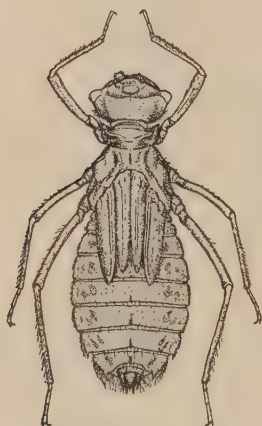


FIG. 48. Nymph of *Somatochlora williamsoni*, x 1.5. (From Walker.)

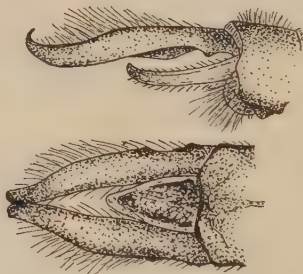


FIG. 49. *Somatochlora williamsoni*, anal appendages of adult. (From Howe.)

Abdomen widest at 6, nearly hairless except along lateral margins where the fringe is of about average length and density and is much longer on the sides of 9 and 10 than elsewhere, some of the hairs on these segments being as long as the lateral margins of 9. Lateral spines on 8 and 9 rather slender, those on 8 one-fifth or one-fourth as long as the margin of the segment, and less than half as broad at base as long, not divergent; those on 9 one-fourth to one-third as long as the corresponding margin, more than twice as long as their basal breadth subparallel. Dorsal hooks

present on segments 5 or 6 to 9, but little elevated and not projecting beyond the hind margin of their segments except slightly in the case of those on 8 and 9; compressed, slightly hooked, with blunt or rounded apices. Lateral and median appendages about as long as 9 plus 10 measured in line with the former.

Measurements: length, 23-25 mm.; length of hind femora, 7-7.3 mm.; width of abdomen, 8-9 mm.

Adult, male.—Color metallic green and black; labrum black.

Thorax: yellow marks on the sides obscured, but a faint indication of a mesothoracic stripe and metathoracic spot.

Abdomen: black with two obscure spots on sides of 2 and at base of 3; anal appendages very similar to *elongata* (Fig. 49) the tips upturned, but differing from *elongata* in having a small basal tooth on the superiors in dorsal view.

Female.—Similar to the male, but the abdomen with prominent yellow spots on the cephalo-lateral angles of terga 4, 5, and 6; pale spots on the sides of 2 unbroken; vulvar lamina long, spout-shaped, laterally compressed, and about as long as the height of segment 9; anal appendages (superiors) a trifle longer than segments 9 and 10 together.

Measurements: total length, male 53.5-59, female 55-59.5 mm.; length of abdomen, male 36-40, female 38.5-42 mm.; length of hind wings, male and female, 35-40 mm.; width of hind wings, male 9.5-11, female 11-12 mm.

Connecticut.—A female collected at Litchfield by L. B. Woodruff and standing under *tenebrosa* in the latter's collection belongs here. It differs from the latter species in having the labrum mostly black and in being provided with lateral yellow spots on segments 4, 5, and 6 of the abdomen.

Group 2. The LINEARIS Group

Somatochlora linearis Hagen

Synopsis of the Neuroptera of North America, 137: 1861.

Nymph (Fig. 50).—Head: hinge of labium reaching a little beyond base of the mesosternum. Mental setae 11 to 12, the 5th and 6th from the outside longest; lateral lobes with 9 crenulations each, with a group of 6 or 7 spines, the longest of which are nearly as long as the corresponding crenulation; lateral setae of the palpi 8.

Thorax: hind wing-cases reaching about the middle of abdominal segment 6.

Abdomen: broadest at segments 5 and 6, 1.5 times as broad as the head across the eyes; no definite fringe of hairs on the hind margins of the abdominal tergites; lateral spines of segment 8 about one-fifth the length of the margin of this segment; those on 9 one-fourth to one-fifth the length of the corresponding segment margin; dorsal hooks on segments 5 to 9 and a vestige on

4, compressed, curved and acute, that of 5 rather more than a third as long as the mid-dorsal length of the segment, increasing in size caudad, that of 9 projecting over the entire 10th segment; median appendage slightly shorter than segment 9 plus 10, and triangular.

Measurements: length, 22 mm.; width of abdomen, 9 mm.; length of hind femora, 6.5 mm.

Adult, male.—Color brown to black, in part feebly metallic.

Head: labium yellow, labrum and clypeus buff; front brown, darker above; vertex, occiput and postgenae brown.

Thorax: brown, with metallic lustre without pale lateral spots; legs black except the coxae, trochanters and part of the femora,



FIG. 50. Nymph of *Somatochlora linearis*, x 1.7. (From Walker.)

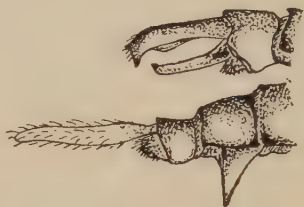


FIG. 51. *Somatochlora linearis*, anal appendages of adult. (From Howe.)

which are brown; entire ventral surface of the hind femora spinose; middle femora with a broad longitudinal band of spines from base to apex; tibiae with ventral keels and flat apical spurs, the keels three-fourths the length of the hind tibiae, but only about one-tenth the length of the middle tibiae and about one-third the length of the front; tarsal claws with ventral tooth slightly beyond the middle; wings clear, slightly flavescent.

Abdomen: slender, narrowed on segment 3, widened gradually from 3 to 6, and slightly narrowed from 6 to 10; segments 1 and 2 widest: segments 1 and 2 brown; terga 2 with a large yellow spot near the lateral margin on each side; terga 3-10 black or dark brown, 3 and 5-7 with a small yellow spot on each side near base; venter largely brown, venter of terga 5-9 with a touch of yellow near the cephalo-lateral angles; anal and accessory appendages black; the superior anals almost truncate at the apex (Fig. 51).

Female.—Superior anal appendages long, the vulvar lamina

projecting ventrad a distance equal to the vertical diameter of segment 9.

Measurements: total length, male 60, female 65-68 mm.; length of abdomen, male 43, female 47-50 mm.; length of hind wings, male 40, female 39-42 mm.; length of stigma, male .3 mm.

Connecticut.—A single male specimen collected by Mr. Zappe at Orange, July 2, 1920.

New England.—July 2-July 27.

Group 3. The TENEBROSA Group

Somatochlora tenebrosa (Say)

Journal of the Academy of Natural Sciences of Philadelphia, 8: 14: 1839.

Nymph (Fig. 52).—Labium reaching base of the mesosternum; mental setae 11 to 12, the third to the sixth from the outside longest; lateral setae of the palpi 8; palpi with 9 or 10 crenulations, the middle ones of which are about three times as long as deep, and bear 6 or 7 setae in a graded series.

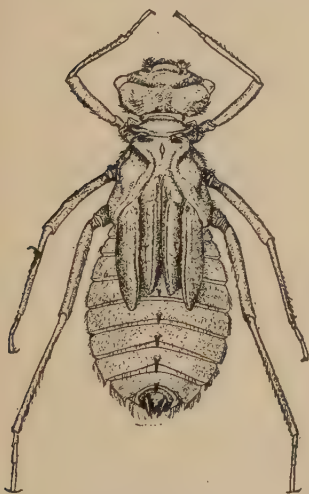


FIG. 52. Nymph of *Somatochlora tenebrosa*, x 2.2. (From Walker.)

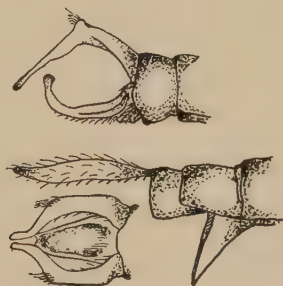


FIG. 53. *Somatochlora tenebrosa*, anal appendages of adult. (From Howe.)

Abdomen: widest at segment 6; lateral spines on 8 and 9, those on 8 about one-sixth the length of the lateral margins of the segments, slightly divergent, those on 9 not divergent, about one-fifth as long as the corresponding segment margin and about three times as long as their basal breadth; dorsal hooks on segment 4 or 5 to 9; vestigial on 4 when present; very small on 5, being about one-fourth as long as the tergite of this segment,

barely half the corresponding length on 6; well developed on the remaining segments, being about as long as the segments that bear them; hook on segment 9 projecting well over the hind margin of segment 10; median appendage about as long as segments 9 plus 10 measured mid-dorsally triangular, in profile somewhat concave above in the male, with a slightly elevated sub-apical prominence.

Measurements: total length, 20 mm.; width of head, 6 mm.; width of abdomen, 8 mm.; length of hind femora, 6 mm.

Adult, male.—Color black and metallic green.

Head: labium pale, labrum yellow with a black ventral border and dorso-mesal spot; front dark above, occiput brown, postgenae black.

Thorax: metallic green and brown with a yellow stripe on the mesepimera and an elongate spot on the metepimera; legs black, the front femora pale at base; wings clear, usually without flavescent areas, sometimes yellow at anal triangle.

Abdomen: second segment with a pale spot shortly above the lateral margin; margins of segment 3 obscurely pale; remainder of the abdomen black, brown beneath; anal appendages (Fig. 53) bent sharply ventrad and mesad, the tips slender. Inferior appendage nearly as broad at tip as at base, three-fourths as long as the superiors.

Female.—Similar to the male, the anal appendages as long as segments 9 and 10 together, the vulvar lamina much narrower at the base than the width of segment 9; length of anal appendages 3.5-4.7 mm.

Measurements: total length, male 55-56, female 58 mm.; length of abdomen, male 40, female 36-40 mm.; length of hind wing, male 38-39, female 37-39 mm.; width of hind wings, male 12, female 12 mm.; length of stigma, male and female, 3 mm.

Connecticut.—Wallingford, 13 August, 1922 (S. W. Bromley).

New England.—August 1-September 8.

Group 4. The FILOSA Group

This group contains *filosa* and *provocans*, of which the latter perhaps is most likely to be found in Connecticut. The anal appendages of the male of *provocans* are shown in Fig. 42, Nos. 7, 8.

Group 5. The ARCTICA Group

Somatochlora forcipata (Scudder)

Proceedings of the Boston Society of Natural History, 10: 216: 1866.

Nymph (Fig. 54).—Very hairy; labium small, eyes entirely uncovered, the submentum reaching scarcely to the middle of the mesocoxae; palpi with 7-9 rounded crenulations, each with three to five setae; lateral setae 9, rarely 10; mental setae 12 to 15, the fourth to sixth from the outside, longest.

Abdomen: dorsum with numerous hairs generally distributed, but not uniform in length, those on the lateral and posterior margins of 9 and on the dorso-lateral parts of the hind margins of 6-9 elongated, forming conspicuous tufts on each side; dorsal hooks absent; lateral spines absent or represented on 9 only by a very minute tooth.

Measurements: length, 19-20 mm.; width of abdomen, 6.6-7.1 mm.; length of hind femora, 5-5.5 mm.

Adult, male.—Color metallic green and black.

Head: pale color of the front on the ventral margin continuous.

Thorax: conspicuous oval yellow spots, two on each side.

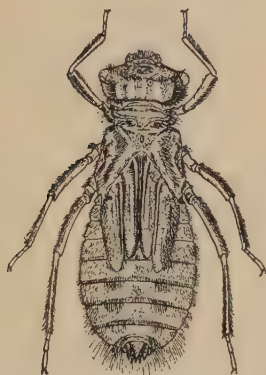


FIG. 54. Nymph of *Somatochlora forcipata*, x 2. (From Walker.)

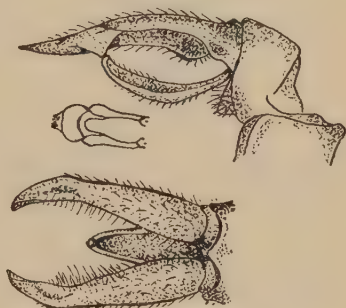


FIG. 55. *Somatochlora forcipata*, anal appendages of adults. (From Howe.)

Abdomen: without pale rings, but with pale spots on the cephalo-lateral angles of segments 5 to 7 inclusive; anal appendages black, the superiors in dorsal view without lateral angles, and forcipate; inferiors more than half the length of the superiors, narrowed at tip and not so broad as at base (Fig. 55).

Female.—Vulvar lamina (Fig. 55) entire; not so long as the height of segment 9 and extending nearly or quite to the caudal margin of the segment; cephalo-lateral pale spots on abdominal segments 4 to 8, that on 8 smaller.

Measurements: total length, male 45-50, female 46-51 mm.; length of abdomen, male 33-34, female 33-36 mm.; length of hind wings, male 31-32, female 30-33 mm.; width of hind wing, male and female, 9-10 mm.; length of stigma, 2 mm.

New England.—May-August.

Somatochlora franklini (Selys)

Bulletin de l'Academie royale . . . de Belgique, 45: 195, 205, 217: 1878.

The accompanying illustrations (Figs. 56, 57) of the nymph

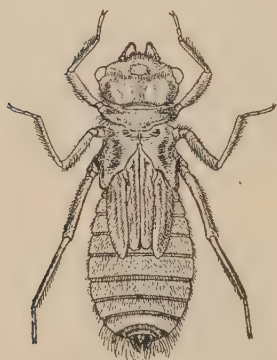


FIG. 56. Nymph of *Somatochlora franklini*, x 2. (From Walker.)



FIG. 57. *Somatochlora franklini*, anal appendages of the adult. (From Howe.)

and adult of the species are shown mainly for the sake of comparison. It has not been seen in Connecticut.

Somatochlora kennedyi Walker

Canadian Entomologist, 50: 371-374: 1918.

Nymph.—Hinge of labium reaching the middle of the meso-coxae; palpi with 9 or 10 crenulations, the largest about three times as long as high and having groups of about four setae in a graded series, the longest of which are three-fourths or three-fifths as long as the crenulations bearing them; mental setae 12-13, the fourth to sixth from the outside longest, the innermost three or four small; lateral setae of the palpi 9.

Abdomen: without dorsal hooks; lateral spines represented on segment 9 only by a small tooth on each side; median appendage of the female nearly equilateral, barely acuminate, and terminating in a small, sharp spine; lateral appendages a trifle longer, about four times as long as their basal breadth; outer margins straight.

Measurements: length, 21 mm.; width of the head, 6.3 mm.; hind femora, 6 mm.; width of the abdomen, 6.5 mm.

Adult, male.—Color black and metallic green.

Head: sides of front and lower margin pale.

Thorax: meso- and metathorax metallic green without well-defined spots; wings clear or tinged with yellow, the hind wings

sometimes with a clear yellow basal spot, which may extend beyond the anal triangle.

Abdomen: greenish black, with dull yellow as follows: a spot on sides of segment 1, sometimes two spots on segment 2, sometimes coalescing, and a pale apical ring on segment 3, with indefinite spots on the cephalo-ventral angles; terga 4 to 10 entirely black; anal appendages (Fig. 58) similar to *forcipata* except for the broken lateral margins in dorsal view and the absence of a subapical inferior tooth in lateral profile.

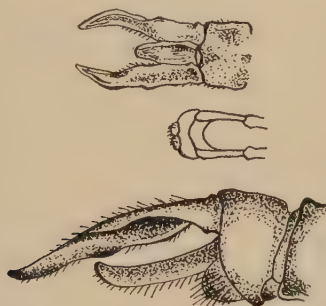


FIG. 58. *Somatochlora kennedyi*,
anal appendages of the adult.
(From Howe.)

Female.—Vulvar lamina (Fig. 58) entire, little contracted at tip, broadly rounded.

Measurements: total length, male 54-58 mm.; length of abdomen, male 35-39, female 34-38 mm.; length of hind wings, male 30-31, female 30-32 mm.; width of hind wings, male and female, 8-10 mm.

New England.—August 1-September 8.

Group 6. The ALPESTRIS Group

Somatochlora albicincta (Burmeister)

Handbuch der Entomologie, p. 847: 1839.

Nymph (Fig. 59).—Hinge of labium reaching nearly to the hind margin of the middle coxae; mental setae 11 or 12, the fourth or fifth from the outside longest, the inner three or four very short; lateral setae of the palpi 5 or 6; crenulations 7 to 8 each with 3 or 4 setae in a graded series.

Abdomen: slightly wider than the head; covered evenly above with minute hairs among which are sparsely scattered longer ones, the hind margin of each tergite with a fringe of short setae, shorter than those of the general surface, with longer and more slender hairs scattered among them, sometimes in small irregular

groups; lateral spines on segments 8 and 9, those on 8 usually less than one-fifth as long as the margin, not divergent, those on 9 about one-fifth the length of the margin; median superior appendage longer than the laterals in profile, faintly convex above; lateral appendages of the male as long as segments 9 and 10 together measured directly in front of them.

Measurements: total length, 20.5-23.5 mm.; width of abdomen, 7.2-8 mm.; length of hind femora, 5.8-6.5 mm.

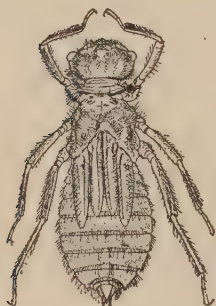


FIG. 59. Nymph of *Somatochlora albicincta*, x 1.5. (From Walker.)

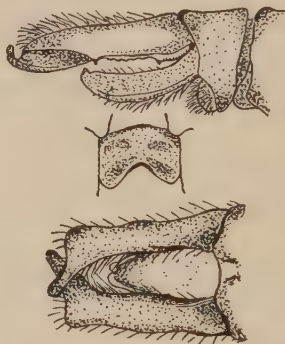


FIG. 60. *Somatochlora albicincta*, anal appendages of the adult. (From Howe.)

Adult, male.—Color metallic green and black.

Thorax: a pale streak on the mesepimera.

Abdomen: pale rings on segments 2 to 8, but without pale spots on the latero-cephalic angles; tips of the anal appendages (Fig. 60) bent sharply mesad at tips, but without a sub-basal, lateral angle when seen in dorsal view.

Female.—Vulvar lamina not projecting ventrad, the lobes broadly rounded and with a notch between.

Measurements: total length, male 47, female 45 mm.; length of abdomen, male 30, female 29 mm.; length of hind wings, male 30-31, female about 33 mm.; width of hind wings, male 9, female 10 mm.

Specimens examined in the Museum of Comparative Zoology.

Walker's measurements for this species are as follows: total length, male 45.3-50, female 46-52 mm.; length of abdomen, male 30-32, female 31-36.7 mm.; length of hind wing, male 28-31, female 29-33 mm.; width of hind wing, male 8-9.125, female 9-10.5 mm.

New England.—July 4-August 11.

***Somatochlora cingulata* (Selys)**

Bulletin de l'Academie royale . . . de Belgique (2), 31: 302: 1871.

Nymph (Fig. 61).—Color dark brown. Readily recognized by its large size and blotched color pattern, especially the abdomen, segments 4-9 each bearing two prominent scars or blotches above on either side.

Head: palpi with six lateral setae, each palpus with seven to eight teeth, the teeth in the middle of the row with about three spines each; caudal margins of the eyes considerably behind the middle of the head.

Thorax: femora each with two dark rings, the hind femora extending caudad to abdominal segment 6.



FIG. 61. Nymph of *Somatochlora cingulata*, x 1.6. (From Walker.)

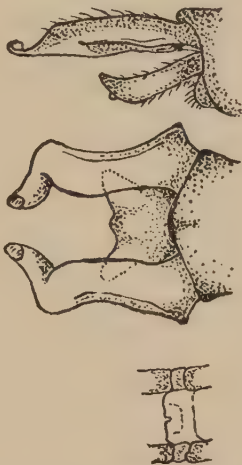


FIG. 62. *Somatochlora cingulata*, anal appendages of the adult. (From Howe.)

Abdomen: without dorsal spines or tubercles, the small lateral spines on segments 8 and 9, .25 to .5 mm. long in full-grown specimens; lateral terminal appendages three-fourths as long as the ventral.

Measurements: total length, 26-28 mm.; hind femur, 7.5 mm.; wing-cases, 6 mm.; median lobe of the labium, 5.5 mm. long by 2.5 mm. to 6 mm. wide; width of abdomen, 8.7-9.1 mm.

Adult, male.—Color metallic green and black.

Thorax: metallic without lateral pale spots; wings clear, not yellow.

Abdomen: pale rings on segments 2 to 9; anal appendages in dorsal view with a sharp sub-basal angle, the tips bent mesad conspicuously (Fig. 62).

Female.—Similar to the male.

Vulvar lamina not projecting ventrad conspicuously, the plates broadly rounded, with a shallow median notch.

Measurements: total length, male 54-63, female 57-68 mm.; length of abdomen, male 36-41, female 39 mm.; length of hind wings, male 33-38, female 35-41 mm.

Genus *Neurocordulia* Selys

Nymphs of this genus have not been reared. Needham has described what he supposes to be the nymph of the only representative. He says it is similar to *Hagenius* and *Epicordulia*, but differs from all nymphs known to him in having curved ridges on the femora of the first two pairs of legs, a transverse occipital ridge and very short basal segments. An exuviae received from Dr. Calvert and compared with specimens from other sources shows that the diverging spines on segment 8 and the very deep teeth of the labial palpi are important characters.

Adults.—Sectors of arculus not united at base, triangle with cross-veins; area between Cu_1 and M_4 widened at the margin of the front wing; dark spots sometimes on wing at base and along costal margin; abdomen of female without a long forked process on venter of 8; color not metallic.

Not much is known of the habits of members of the genus. The only representative collected in Connecticut was found near a fairly large stream in the northern part of the State. It was collected between 3:00 and 6:00 P. M. and was found resting in some weeds in a woodland pasture.

Key to Species

Adults

- I. Antenodals in front wings 7 to 8, those behind Sc infuscated as far as the nodus; a nodal spot also present**obsoleta**
- Antenodals in front wings 9 to 11, those behind Sc not infuscated as far as the nodus and without a nodal spot**yamaskanensis**

Neurocordulia obsoleta Say

Journal of the Academy of Natural Sciences of Philadelphia, 8: 29: 1839.

Nymph (Pl. iv, Fig. 6).—Color dark brown.

Head: mentum about as broad as long, extending between the procoxae and with 9 mental setae on each side; palpi with 6 lateral setae, and 6 mesal teeth, which are longer than broad and have several spines at their apices; mesal margin of palpi also setose; the first tooth below the movable spine or distal segment of the palpi is bifid. Antennae 7-segmented, the third and sixth subequal and longer than the rest; ventral margin of labrum setose; location of the ocelli marked by pale spots; vertex and occiput

granular, the caudal margins rounded, but with a distinct ridge approximated to the anterior margin of the pronotum.

Thorax: pronotum with a ridge on the caudal margin which curves forward on the sides and ends in a blunt tubercle; just above the procoxae there is a single blunt protuberance; sides of the meso- and metathorax dark brown, spotted with yellow; pro-, meso-, and metacoxae successively further apart in the order mentioned; femora brown, with two yellow rings on each, without carinae; tibiae with 2 yellow rings each, and a curved ridge beginning on the cephalic surface at base, curving on to the ventral surface and disappearing at about the mid point; tarsi dark brown, the distal segment about as long as the two proximal; metathoracic wing-cases extending to the middle of abdominal segment 5.

Abdomen: flat below, arched above, the lateral keels with conspicuous spines on 8 and 9 as in Pl. iv, Fig. 6; dorsal surface with mesal hooks on 1-9; segment 10 narrow, about one-fourth as long as 9; superior anal appendage almost triangular, the lateral appendages three-fourths as long as the superiors; the dorsal surface of the abdomen is granular in appearance owing to the presence of small setae, but there is a double row of smooth scars 4-8 and a single scar on 2, 3 and 9.

Measurements: total length, 21 mm.; length of hind femora, 5.5 mm.; length of metathoracic wing-cases, 5.5 mm.; length of abdomen (to tip of lateral spines), 13 mm., greatest width, 9 mm.

Described from a cast skin obtained from Dr. P. P. Calvert.

Adult, male.—Color brown marked with yellow.

Head: brown, labrum yellow, front and vertex olive.

Thorax: pale brown, pilose with a yellow spot on the metepisterna covering the spiracle; legs brown; wings (Pl. x, Fig. 4) smoky with a patch of dark brown on the anal angle in the hind wing, and another patch on base of front wing; antenodal cross-veins infuscated and a dark spot on the nodus, which may, however, be absent.

Abdomen: brown to black; anal appendages with the inferior entire, tapering to an acute point; superiors viewed from above, expanded on the distal half as in *Tetragoneuria simulans*.

Female.—Vulvar lamina consisting of short lobes, less than 1 mm. long, and separated by about the width of each lobe at middle.

Measurements: total length, male 45, female 42-45 mm.; length of abdomen, male 28-30, female 30 mm.; length of hind wings, male 28-30, female 32 mm.; width of hind wings, male 10, female 8-10 mm.

Specimens examined in collection of P. P. Calvert; one female in this collection has very little coloring in the wings and almost none in antenodal cross-veins; also one specimen from Squam Lake, N. H., obtained from Dr. Howe.

New England.—June 10-August 30.

Neurocordulia yamaskanensis (Provancher)

Naturaliste Canadienne, 7: 238, 248: 1875.

Adult, male.—Brown, labrum yellow, front and vertex olive.

Thorax: brown, pilose; legs brown, the dorsal ridges of the tibiae pale; wings with brown spot at base of the hind wings, not, however, extending beyond the triangle; front wings chlorinated as far as the arculus, the first two antenodals showing some infuscation, but without a dark spot reaching the hind margin as in *obsoleta*; antenodals of the front wing 9 to 11, hind wings usually 6.

Abdomen: brown, bulbous at base, with pale spots along the sides of segments 5 to 8 inclusive; inferior appendage nearly as long as the superiors, contracted to a blunt point at apex; superior appendages slender, acute, the tips upturned and in lateral profile with a slight obtuse projection on the ventral surface just beyond the middle.

Female.—Similar in nearly all points to the male. Vulvar lamina consisting of two small plates with an almost rectangular notch between.

Measurements: total length, male 52-53, female 52 mm.; length of abdomen, male 35-37, female 37 mm.; length of hind wings, male 33-35, female 36 mm.; width of hind wings, male and female, 11 mm.

This species is similar in nearly all respects to *obsoleta* of Say but differs mainly in size, greater number of antenodal cross-veins, and amount of infuscation on these. The species has been described in great detail by Hagen (*Psyche*, 5; pp. 367-369, pl. I, figs. 1-6: 1890). The wings are figured by Williamson in *Ent. News*, 19: pl. XVIII: 1908.

Connecticut.—Salisbury, 13 June, 1926 (P. G.).

Genus Williamsonia Davis

Generally placed in *Dorocordulia* but separated from that genus by some authorities because of the absence of a 3-celled internal triangle.

Williamsonia (*Dorocordulia*) *lintneri* (Hagen) is the only representative in New England.

Nymphs.—Unknown.

Adults.—Sectors of the arculus not united at base; triangle without cross-veins; area between Cu_1 and M_4 not widened at margin of the front wing; wings without dark spots, their bases however, flavescent; abdomen of female without a long forked process on the venter of segment 8.

Williamsonia lintneri (Hagen)

Bulletin de l'Academie royale . . . de Belgique (2), 45: 187: 1878.

Adult, male.—Color brown or yellow and black.

Head: face brown, vertex black or brown; occiput and post-genae black.

Thorax: metallic green and brown, legs black, the femora with very short spines; wings (Pl. xvi, Fig. 1) clear with the extreme bases yellow; triangles without cross-veins; postnodal cross-veins five to six in the front wings, antenodals seven to eight in the front and five in the hind wings.

Abdomen: terga 2 to 9 with pale apical transverse bands about one-third the length of each segment; anal appendages black, the superiors bluntly rounded at the tips and slightly swollen apically.

Female.—Vulvar lamina consisting of two pointed lobes in contact on the meson and a little more than half the length of the segment; median incision about three-fourths the length of the lobes.

Measurements: total length, male 31-34, female 33-36 mm.; length of abdomen, male 21-22, female 22-23 mm.; length of hind wing, male 21-22, female 22-25 mm.; width of hind wings, male 7, female 8 mm.

This species probably occurs in Connecticut, but so far it has not been collected. According to Dr. R. H. Howe, Jr., it flies only in April and May, and may be taken in woods, usually near sphagnum ponds. It has been found in several localities in Massachusetts.

New England.—April 30-June 21.

Genus Dorocordulia Needham

Nymphs.—Caudo-lateral margins of the head angular; spines of abdominal segment 9 one-third as long as that segment.

Adults.—With arculus sectors separate to point of union with arculus; triangles of the front wings usually without cross-veins; subtriangle absent; area between M_4 and Cu_1 not expanded towards margin of front wing; bases of hind wings clear; color metallic.

*Key to Species***Adults, Males**

1. Abdomen with segments 7-10 spatulately dilated; wider than the preceding segments **libera**
- Abdomen with segments 7-10 not spatulately dilated; not wider than the preceding segments **lepida**

Females

1. Abdominal segments 4-7 without conspicuous yellow spots on the cephalo-lateral angles; width of segment 9 more than 2 mm. ... **libera**
- Abdominal segments 4-7 with conspicuous yellow spots on the cephalo-lateral angles; width of segment 9 less than 2 mm. ... **lepida**

Dorocordulia lepida (Hagen)

Bulletin de l'Academie royale . . . de Belgique (2), 31: 264: 1871.

Nymph.—Head: labium with 10 to 11 setae on each side of the mentum; labial palpi with 7 setae on each side, that on the base well separated from the remaining setae; teeth of the distal margins of the palpi shallow and provided with two to three spines each.

Abdomen: dorsal hooks on segments 5 to 9 inclusive; lateral spines on segments 8 and 9.

Measurements: total length, 19 mm.; length of abdomen, 10 mm.; length of metathoracic wing-cases, 5 mm.; length of hind femora, 6 mm.

A nymph seen in the collection of William T. Davis, from which the measurements were taken, and a labium received through the courtesy of Dr. R. H. Howe—both reared specimens.

Adult, male.—Color metallic green, black and yellow.

Head: labium brown; labrum black, anteclypeus brown; postclypeus and front green except the sides of the front below the antennae, which are brown; postocular triangle brown, occiput and postgenae black.

Thorax: metallic green, pilose, and obscurely marked with yellow and black; legs mostly black, the front femora and coxae brown; wings clear, yellow at base; postnodal cross-veins of the front wing 5, stigma black, supported by one cross-vein.

Abdomen: black, obscurely marked with yellowish brown on the sides of terga 1 and 2; anal appendages black, accessory appendages similar to those of *Cordulia*.

Female.—Color similar to the male.

Abdomen: yellow on sides of tergum 2, nearly all of 3 yellow, and yellow triangles on 4-7; vulvar lamina consisting of two rounded lobes, extending one-third to one-half the length of the segment from its base; anal appendages black, the superiors about as long as segment 9.

Measurements: total length, male 37, female 37 mm.; length of abdomen, male 25-26, female 27 mm.; length of hind wings, male 27-28, female 28-29 mm.; width of hind wings, male 8-9, female 9-10 mm.

Connecticut.—New London, 16-22 June, 1921 (R. H. H.); Litchfield, 31 August, 1913 (L. B. W.).

New England.—May 22-August 31.

Dorocordulia libera (Selys)

Bulletin de l'Academie royale . . . de Belgique (2), 31: 263: 1871.

Nymph.—Color dark brown, with darker stripes, resembling in general form the *Somatochloras*.

Head: with prominent black transverse band between the eyes, above which is a lighter band about half as wide; antennae with

first two segments brown (tip of second lighter), setose; a prominent fringe of setae between the antennal bases; rear of head brown with a few setae on caudo-lateral angles; labium with 10-12 mental setae and 7 lateral setae on the palpi, with a group of about 10 small spinules at base; teeth of palpi short with a tendency to overlap, the middle teeth with four spines; 8 notches on each palpus.

Thorax: mid-dorsum of pronotum black; two broad black bands on sides of the mesa- and metathorax, the dorsal stripe extending onto the sides of the pronotum, the ventral stripe consisting of a short dash over the metacoxae; wing cases black or very dark, their dorsal margins pale; legs brown without conspicuous rings.

Abdomen: brown, with narrow mid-dorsal pale line; sides obscurely mottled, the lateral scars on 5 to 8 paired and frequently with brown spots alongside; dorsal hooks almost obsolete, most distinct on segments 6 and 7, indicated as small elevations on 5 and 8; lateral spines on 8 and 9 short, that on 8 one-seventh as long as the lateral margin, that on 9 a trifle longer, both incurved; lateral and ventral margins of 9 with very long hairs or setae, those of the ventro-caudal margin extending twice as far to the rear as the terminal appendages; caudal margins of 7 and 8 with a few long setae on either side of the dorsum and several grouped about the dorsal prominences; terminal appendages together with segment 10 well telescoped into segment 9; laterals about three-fourths as long as the ventrals.

Measurements: total length, 18 mm.; length of abdomen, 11 mm., greatest width, 7 mm.; length of hind femora, 5.5 mm.

Described from two reared specimens and a number of full-grown nymphs. It differs from *lepida* in lacking a dorsal hook on segment 9.

Adult, male.—Color metallic green and black; base of abdomen with brown or yellow marks.

Head: labium brown, labrum and anteclypeus black or dark brown, front and postclypeus metallic green; occiput and postgenae black; compound eyes bright green below, brown above; in preserved specimens entirely brown.

Thorax: pronotum black with caudal lobe and frontal margin brown; meso- and metathorax metallic green and bronze, the sutures slightly darker; legs black, the tibiae of the hind legs each with a pronounced ventral ridge with spine-like projection at tip; wings (Pl. x, Fig. 3) clear, with 7-8 postnodal cross-veins; 7-8 antenodal cross-veins in the front wing and 5 in the hind.

Abdomen: dark metallic green or black with brown or yellow marks on the sides of terga 2 and 3; anal appendages black, the superiors in lateral profile with a tooth at base, the distal half expanded and the tips sharply pointed and upturned; inferior appendage nearly as long as, or longer than the superiors, the tips

narrowed almost to a point; abdomen viewed from above with segments 7-9 spatulately dilated, segment 8 being three or more millimeters in width.

Female.—Vulvar lamina not quite half (1.0 mm.) as long as segment 9, and with a narrow median notch. First and second, and one-third of segment 3 brown or yellow; segment 2 sometimes black, and 3 with only a basal ring.

Measurements: total length, male 40, female 40 mm.; length of abdomen, male 28-29, female 28-31 mm.; length of hind wings, male 28-29, female 29-30 mm.; width of hind wings, male 9, female 10 mm.

Connecticut.—Bristol, 6 July, 1922 (P. G.); Hamden, 23 May, 1927. Emerged in laboratory (P. G.). Two specimens also from vicinity of Storrs, without date or place. Reported from Litchfield (L. B. W.), Union (S. W. B.) and Rainbow, 13 June, 1927 (R. B. F.).

New England.—June 7-August 29.

Subfamily LIBELLULINAE Selys

The nymphs have, for the most part, short lateral spines on the abdomen, and the lateral appendages are less than half as long as the inferiors.

The adults have a decided double curve in the mesopleural suture, lack for the most part the metallic coloration common in the Cordulinae, and the compound eyes usually have the prominent tubercle in the middle of the hind border.

As already mentioned, the subfamily Libellulinae is very closely related to the Cordulinae, and much care must be exercised in order to put an unknown species in its proper place.

Tribe LIBELLULINI Tillyard

Nymphs of this tribe have squarish heads when viewed from above, and the labium is of characteristic form (see Pl. VII, Fig. 5). The adults of local representatives have a decided bend in vein M_2 as shown in Pl. xv, Fig. 3, the wings in general containing taxonomic features of considerable importance. Females with small vulvar lamina, the margin of segment 8 often thin and extended ventrad.

Key to Genera

Nymphs

1. Distal margin of mentum crenulate, with a single crenulation between the marginal spines; distal margin of labial palpi with seven notches between conspicuous teeth; no dorsal spine on abdominal segment 7 *Plathemis*, p. 254
- Distal margin of mentum usually with more than a single crenulation between each marginal spine; if with a single crenulation, then with a dorsal spine on abdominal segment 7; distal margin of labial palpi with 10 to 11 notches in full growth nymphs

Libellula, p. 241

Adults

- 1. Male with prominent ventral hook on first abdominal segment; structure of ventral surface of abdomen of the female as shown in Fig. 63, No. 2Plathemis, p. 254
- Male without a prominent ventral hook on the first abdominal segment; ventral surface of abdomen of female not as in Fig. 63, No. 2Libellula, p. 241

Genus *Libellula* Linnaeus

Nymphs.—Head with 5 to 9 lateral setae on the palpi, and 8 to 12 on mentum. Dorsal hooks on abdomen present or rudimentary, the lateral spines on segments 8 and 9 small; anal appendages not decurved; laterals about half the length of the inferiors.

Adults.—Front wrinkled, the vertex projecting over the median ocellus, truncate and usually concave at tip when viewed from above; wings with more than 10 antenodal cross-veins; stigma with proximal and distal margins parallel, more than three times as long as wide, and supported by three or more cross-veins; triangle 3-sided and considerably farther distad in the front wings than in the hind; vein M_2 with a conspicuous bend about as far distad as the proximal end of the stigma; subtriangle absent; Cu_1 arising exactly from the caudal angle of the triangle in both wings; prothorax with caudal margin entire; meso- and meta-thorax hairy; femora, tibiae and tarsi with a double row of heavy spines beneath, the femora usually with one dorsal carina and the tibiae with two; tarsal claws with ventral tooth considerably beyond the middle, the proximal portion of the claws much thicker than the distal; abdomen without ventral hooks on the first abdominal segment of the male; transverse median carinae on segments 2 and 3 sometimes wanting on 2; general color usually brown or black, often becoming pollinose.

For literature on adults of the genus, see

Byers, C. F. Ent. News. 38: 113-115: 1927. (Key to *Libellula* nymphs.)
Ris, F. Catalogue des Collections Zoologiques du Baron Edm. de Selys Longchamps. Libellulinen; xi: 245-282: 1910.

For the most part fresh water species are included in this genus, although the only representatives of *auripennis* were taken near brackish water. The nymphs occur in trash near the borders of ponds or streams. The adults are perhaps our most common dragonflies occurring throughout the summer in many localities.

Key to Species

Nymphs⁸⁰

- 1. Dorsal hooks on the seventh and eighth abdominal segments, long and sharp 2
- Dorsal hooks on the seventh and eighth abdominal segments rudimentary, hidden among scurfy hairs or wanting 6

⁸⁰ This key applies only to full-grown individuals.

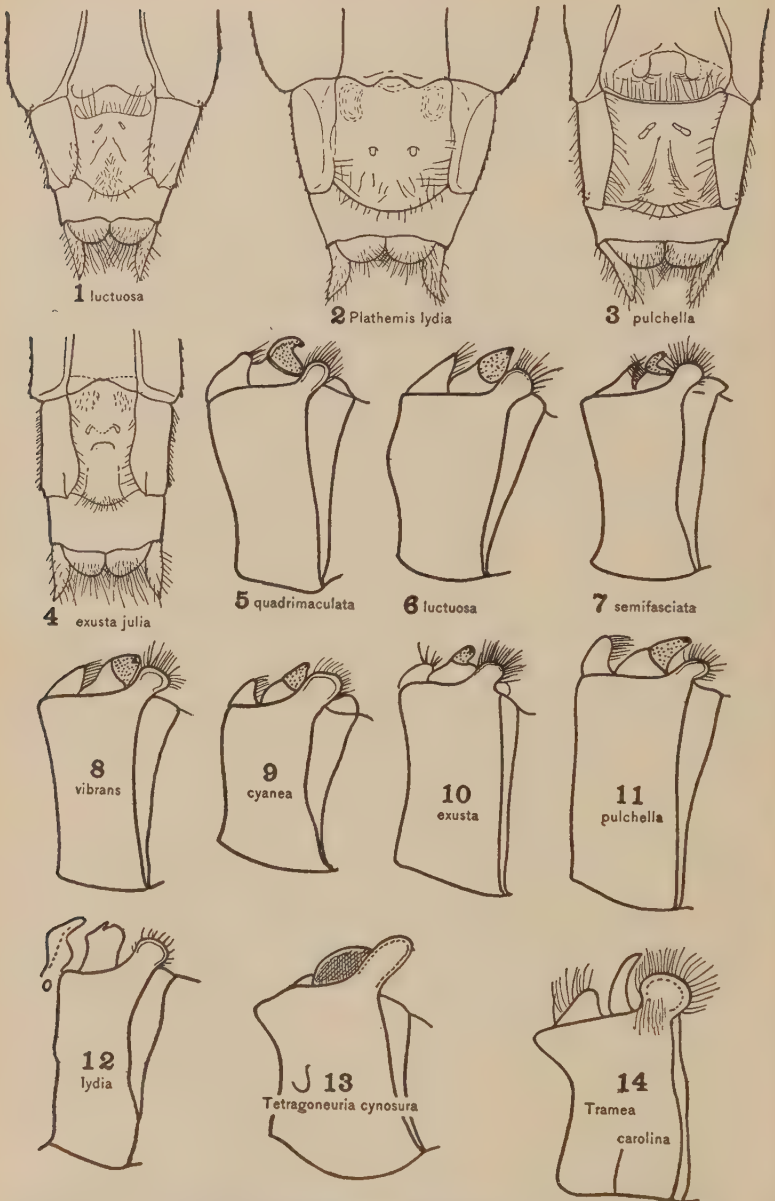


FIG. 63. Ventral view of terminal segments of female abdomens of *Libellula* 1, 3 and 4, and *Plathemis*, 2. Accessory appendages in lateral view, 5-11 *Libellula* species, 12, *Plathemis lydia*. 13, *Tetragoneuria cynosura*. 14, *Tramea carolina*; all greatly enlarged.

2. Distal margin of the mentum crenulate (Pl. VII, Fig. 5)**exusta**
- Distal margin of the mentum not crenulate, not as in Pl. VII, Fig. 5 3
3. Lateral setae of the labial palpi five 4
- Lateral setae more than five 5
4. Segment 9 on ventral side equal in length to 9 and 10 on the dorsum; setae on distal margin of lateral lobes of labium in groups of three**vibrans inesta**
- Segment 9 on ventral side longer than 9 and 10 on the dorsum; setae of distal margin of lateral lobes in groups of five ..**auripennis**
5. Lateral setae of the labial palpi six**cyanea**
- Lateral setae seven**luctuosa**
6. Lateral setae of the labial palpi seven**quadrimaculata**
- Lateral setae eight or nine (Pl. VII, Fig. 1)**pulchella**

Adults

Males and Females

1. Wings clear, without spots, occasionally with dark tips, never with dark basal marks 2
- Wings spotted with dark pigment, always with dark basal marks .. 3
2. Wings suffused with gold, veins reddish yellow; stigma orange or brown (Pl. XXI, Fig. 5)**auripennis**
- Wings clear, veins not reddish yellow; stigma black (Pl. XXI, Fig. 2)**vibrans inesta**
3. Stigma bicolored, yellow or cream-colored and black 4
- Stigma unicolored, usually black 5
4. Stigma of front wing 4 to 4.5 mm., proximal half or three-fifths yellow or cream-colored (Pl. XXI, Fig. 6; Pl. XV, Fig. 3) ..**cyanea**
- Stigma of front wing 5.5 to 6 mm., proximal three-fourths to five-sixths yellow**flavida**
5. Wings with black bases, the black or fuscous area occupying the entire width of the wing (Pl. XXI, Fig. 3)**luctuosa**
- Wings with dark streaks at bases or without spots, the spots if present not occupying the entire width 6
6. Tips of wings clear and without cross-bands at stigma 7
- Tips of wings dark or with dark cross-bands at stigma 8
7. Wings with a dark triangle at the base of the hind wings; no mark at the nodus (Pl. XX, a)**exusta**
- Wings with a dark triangle at the base of the hind wings and also a spot at the nodus, Pl. XXI, Fig. 4**quadrimaculata**
8. Nodal spot not extending behind R (Pl. XXI, Fig. 8) **vibrans vibrans**
- Nodal spot extending behind R, about half the width of the wing 9
9. Extreme tip of wings almost clear; wings suffused with gold at their bases; no whitish areas between the darker spots (Pl. XXI, Fig. 9)**semifasciata**
- Extreme tip of wings usually covered with the apical band; wings not suffused with gold at their bases; usually marked with whitish areas between the darker spots (Pl. XXI, Fig. 7)**pulchella**

Libellula auripennis Burmeister

Handbuch der Entomologie, 2: 861: 1839.

Nymph.—Lateral setae of the palpi five; mental setae 8 to 10; dorsal hooks on segment 3 or 4 to 8.

Measurements (Needham, 1901): total length, 27 mm.; length of abdomen, 17.3 mm.; width of abdomen, 7 mm.; length of hind femora, 6 mm.

Adult, male (Pl. XXI, Fig. 5).—Color red and brown, sometimes lacking red entirely.

Head: labium brown, labrum, clypeus and front red; front with a black basal line in front of the ocelli; occiput and postgenae red or brown.

Thorax: uniformly reddish brown; legs brown, the tibiae with long black spines, tarsal segments darker at tips, ventral tooth of tarsal claws well beyond the middle; wings with reddish and brownish infuscation somewhat heavier along the costal borders; 15-19 antenodal cross-veins in the front wing; postnodals 12-17; stigma brown or red covering 4-5 cells in the front wing and 5.5-6 mm. long.

Abdomen: uniform red, slender, tapering gradually from base to tip, with a blackish line along the dorsal carina, sometimes obscure on 3 to 7, more distinct on segments 8 and 9; accessory appendages as in *L. cyanea*; anal appendages red to brown, the inferior about twice as wide at base as at apex; the superiors with 8 to 11 black teeth beneath.

Female.—More brown or yellow than the male, the tips of the wings sometimes infuscated. Margins of eighth terga extending ventrad considerably.

Measurements: total length, male 52-55, female 50 mm.; length of abdomen, male 31-36, female 30-33 mm.; length of hind wings, male 35-40, female 33-37 mm.; width of hind wings, male 10-10.5, female 11 mm.; length of stigma, male 5-5.5, female 5-6 mm.

Connecticut.—Seven specimens taken at New Haven, 20, 22, and 27 July, 1924, by P. G., J. L. R. and B. H. W.

New England.—July 4-September 13.

***Libellula cyanea* Fabricius**

Systema Entomologie, 424: 1775.

Nymph.—Head: caudo-lateral margins with long scurvy hairs; mentum with 12 setae on each side, of which the six inner ones are much shorter than the rest; distal margin with about 12 short spines on each side with 2 to 4 crenulations or serrations between each; palpi with 6 lateral setae and a group of small setae at the base near the articulation; distal margins of the proximal segment of the palpi with 10 to 11 notches, the teeth between each with 1 to 4 spines in a graded series, the longest about twice the length of each tooth.

Abdomen: heavy dorsal hooks on segments 4-8 inclusive, prominently elevated and extending to the caudal margin of the segment bearing them, or a little beyond; caudal margins of segments 5-9 with long sparse hairs, their bases nearly on the line of small spines; most of the hairs, however, slightly in front; dorsum and lateral margins of the superior median terminal appendage also sparsely setose; lateral spines present on segments

8 and 9, the length of those on 9 fully equal the dorsal length of segment 10; lateral appendages one-half the length of the superior median.

Measurements; exuviae: length of abdomen, about 11 mm.; greatest width, 7 mm.; length of the mentum, 4.5 mm. Reared specimen collected at East Haven, 2 May, 1926, and emerging 25 May, 1926.

Adult, male.—Color dark brown to bluish black and buff.

Head: labium buff, labrum dark brown, clypeus and front brown (teneral); labrum black, clypeus and front dark brown in older specimens; vertex brown or black, the apex truncate and concave when viewed from above; occiput brown to black, pale between the compound eyes on the meson (teneral), and with indefinite pale spots on the lateral margins behind the compound eyes.

Thorax: prothorax brown, the notum, including caudal margin, cream-colored (teneral), black when old; caudal margin of the notum entire, and with only a few hairs; meso- and metathorax dark brown (entirely black or bluish in older specimens) and with a mid-dorsal buff stripe, a wide lateral streak beginning at the base of the hind wings and ending at the caudal margin of the kat-episternum of the mesothorax; metepimera all pale except the dorsal border. Thoracic venter dark brown; legs black, the coxae and trochanters paler, and frequently part of the femora also; wings (Pl. xv, Fig. 3) with a short basal streak between Sc and R, occupying 2-3 antenodal cells; postnodal cells, and cells beyond stigma to tip of the wing flavescent; stigma widest about the middle, the proximal half or two-thirds cream-colored, the remainder brown.

Abdomen: brown and yellow (teneral), or entirely bluish black (old), the younger individuals with a yellow stripe on each side; venter brown; surface of abdomen with but few hairs; anal appendages black, the superiors but little longer than the inferior; hamules of the second segment with lateral lobes reduced to a ridge on the side of the median lobes, the latter bearing at their tips strong black hooks; accessory appendages as in Fig. 63, No. 9.

Female.—Similar to the male; wings darker, especially the tips, which are heavily infuscated; abdomen with broad yellow stripes on each side from base to tip.

Measurements: total length, male 43-47, female 41 mm.; length of abdomen, male 26-29, female 25-27 mm.; length of hind wings, male 33-35, female 33-35 mm.; width of hind wings, male 10, female 9-10 mm.; length of pterostigma, male 5, female 4.5-5 mm.

Connecticut.—New Haven, 17 June, 1902 (E. J. S. M.); New London, 8-22 June, 1921 (R. H. H.); Hamden, 4 July, 1921 (P. G.).

New England.—May 24-September 4.

Cyanea is closely related to *L. flavida* Rambur (*plumbea* Uhler), which is regarded by some as a synonym. The latter has a range well to the south of Connecticut but is found in New Jersey and may at some time be taken in this State. It seems to be a fairly distinct species although the characters intergrade, as pointed out by Calvert (Ent. News, 18: 201-204: 1907). The species *flavida* is larger than *cyanea*, and the pterostigma is yellowish in contrast with the usual cream color of *cyanea*. The pterostigma of *flavida* is also longer and narrower than that of *cyanea*, measuring 5.5 to 6 mm. by 1 mm., or a trifle more in width, whereas that of *cyanea* rarely measures over 5 mm. in length and is 1.3 mm. in width.

Libellula exusta Say

Journal of the Academy of Natural Sciences of Philadelphia, 8: 29: 1839.

Nymph.—Color dark brown.

Head: caudo-lateral margins with long setae; labium as in Pl. VII, Fig. 5, the distal margin of the mentum crenulate with a single spine between each crenulation; lateral setae of the palpi five; mentum with three small setae on each side and a number of very small ones mesad of these; teeth of the labial palpi very shallow.

Thorax: uniformly colored including the legs.

Abdomen: conspicuous dorsal spines on segments 4 to 8 inclusive; terminal appendages long, the laterals, however, only one-fourth to one-third as long as the ventral appendages.

Measurements: length of hind femora, 4 mm.; length of meta-thoracic wing-cases, 5.2 mm.; length of abdomen, about 14 mm.

Described from the exuviae of a single reared specimen collected Hamden, May, 1923; emerged 21 May, 1923.

Libellula exusta Say, var. julia Uhler

Proceedings of the Academy of Natural Sciences of Philadelphia, 88: 1857.

Adult, male (Pl. xx, a).—Color brown to black; frequently pollinose.

Head: labium brown; labrum yellowish; clypeus and front grayish brown, ocellar area nearly black; vertex and rear of head yellowish brown to almost black, with one or two obscure yellow spots behind the caudo-lateral margin of the compound eyes.

Thorax: dark brown, the lateral third of each mesepisterna being much darker than the remainder of the thorax; dorsum of thorax including the mesal two-thirds of the anepisterna usually pollinose and in older specimens white; legs black, coxae, trochanters, and femora a trifle paler; ventral tooth of the tarsal claw beyond the middle; wings mostly clear, the front wings with an opaque dash between Sc and R + M extending to the first ante-

nodal cross-vein; there is always more or less yellow color surrounding this dash and there is sometimes a second dash between Cu and A, but only half the length of the first mentioned; hind wings with an opaque dash between Sc and R + M from base to the first cross-vein and a triangular-shaped area from Cu to the caudal end of the membrane, the distal angle of the opaque area extending to within 1 mm. of the triangle; antenodal cross-veins 14-16 in front, 11-13 in hind wing; postnodals 10-12 in front wing and 11 in the hind.

Abdomen: dorsum of terga 2-4 usually pollinose and sometimes also the cephalo-lateral angles of 5 (faintly so in teneralis); the first segment much darker in color, and the venter of segments 1-10 brown; dorsum of terga 5-10 black in older individuals; mid-dorsum black, and sides brown in younger specimens; superior anal appendages of the usual form; inferior broad, flattened, the lateral margins convex, and the tip with two black teeth projecting upwards. Accessory appendages consisting of inconspicuous cephalic lobes; hamules with a broad basal lobe, and a hook projecting ventrad from about the middle, the apical tooth horizontal and bent laterad; genital lobes about the size of the basal lobe of the hamule and provided with long black setae (Fig. 63, No. 10).

Female.—Color similar to the male, but terga 2-4 frequently not at all pollinose, the abdomen being largely brown, with a mid-dorsal black stripe from base to tip; lateral carinae (Pl. XXII, a) of segment 8 not projecting ventrad, though when viewed from below, the sterna of 8 and 9 appear considerably depressed below the margins of the terga; vulvar lamina consisting of two small well-separated plates about .5 mm. wide by .25 mm. long, the caudal margins convex (Fig. 63, No. 4).

Measurements: total length, male 37-41, female 37 mm.; length of abdomen, male 23-24, female 22-23 mm.; length of hind wings, male 31-33, female 31-32 mm.; width of hind wings, male 9-10, female 10-11 mm.; length of stigma, male 2.5-3.5, female 3.5-4 mm.

The varieties *Libellula e. exusta* and *Libellula e. deplanata* are said to differ mainly in the amount of pollen, the thorax being largely dark brown with greenish stripes on the lateral margins of the episterna. The female of *L. e. exusta* has the vulvar lamina connected by a small plate on the meson. Accessory and anal appendages are the same as *L. e. julia*. *Deplanata* has the brown at the base of the hind wings divided.

A male in the Yale collection, from Salem, Massachusetts, and referred to *L. e. exusta*, has the brown color at the base of the hind wings extending half way to nodus. The abdomen is pollinose except the last two or three segments, the pale stripes of the mesepisterna are yellow, and the opaque spot of the hind wings

extends to the distal end of the triangle. Two specimens from Deep River, Connecticut, agree with this, but the abdomen is not pollinose.

Connecticut.—Var. *julia*.—New Haven, 27 May, 1903 (B. H. W.); Colebrook, 19 June, 1920 (P. G.); Hamden, 1 June, 1921 (W. E. B.), May, 1922 (P. G.); New London, 7-15 June, 1921 (R. H. H.); Mansfield, May, 1923 (L. B. P.); Litchfield, 20 June, 1908, 8 July, 1909 (L. B. W.).

Var. *exusta*.—New London, 6-16 June, 1921 (R. H. H.); Deep River, 1 June, 1923 (P. G.).

New England.—May-July.

Libellula luctuosa Burmeister²¹

Handbuch der Entomologie, 2: 861: 1839.

Nymph.—Head: labial or lateral setae seven; mental setae eight; teeth of the palpi very shallow.

Thorax: wing-cases extending to abdominal segment 4, hind femora to 5 in full-grown specimens.

Abdomen: dorsal spines on segments 2 to 8; with few or no long hairs as in *pulchella*.

Measurements: total length, 21 mm.; length of abdomen, 11 mm.; hind femora, 5.5 mm.

Adult, male (Pl. XXI, Fig. 3).—Color black and dark brown.

Head: labium dark brown; labrum, clypeus, front, vertex and occiput nearly black (clypeus and front brown in teneral); front rugose, the vertex projecting over the median ocellus in a single truncated lobe (sometimes feebly concave at tip); postgenae with two very faint yellow spots on each side behind the lateral margins of the compound eyes.

Thorax: prothorax uniform dark brown, the caudal margin entire and with a few dark hairs; meso- and metathorax also uniform brown, the dorsum somewhat darker than the sides; and an obscure dark line from the base of the hind wings to the kat-episterna of the mesothorax; thoracic venter dark brown; legs black, coxae and trochanters lighter; femora with a single dorsal carina each; the tarsal claws with the ventral tooth placed well beyond the middle, the claw widened considerably proximad of the tooth; entire base of the wings brown, the dark area frequently extending to the nodus in the hind wing, usually three-fourths the distance to nodus in the front wing; beyond the brown area of the wing there is frequently a white semitransparent area, especially in older specimens; wing-veins black. The thorax does not usually become pollinose in older individuals but grows steadily darker, becoming almost black. Teneral have a light mid-dorsal stripe which continues onto the meso- and metanotum.

Abdomen: black and brown, in older individuals bluish pollinose, especially towards the tip; terga with a broad stripe on

²¹ = *basalis* Say.

each side of the dorsum extending from the first segment where the two lines unite, to the caudal margin of the eighth segment, the stripes gradually narrowed caudad; venter of the terga with somewhat similar stripes one on each side, extending from 3 to 8, and gradually narrowed caudad; anal appendages black or dark brown, the superiors but little longer than the inferiors; hamules of the second abdominal segment composed of large mesal hooks, the lateral lobes reduced to an acute ridge (Fig. 63, No. 6), abdomen with very few and very short hairs and appearing glabrous in most individuals; terga 2 and 3 with median transverse carinae.

Female.—The clypeus and front are brown; the brown marks of the wings do not extend quite so far distad as those of the male; tips of wings between stigma and apex, flavescent; lateral abdominal stripes of the abdomen are somewhat broader; lateral margins of terga 8 not leaf-like or produced ventrad; genitalia as in Fig. 63, No. 1.

The dark base of the wings is characteristic of both sexes.

Measurements: total length, male 43-45, female 42 mm.; length of abdomen, male 25-26, female 25 mm.; length of hind wings, male 36-39, female 39 mm.; width of hind wings, male 12-13, female 12-13 mm.; length of stigma, male and female, 4-5 mm.

Connecticut.—Berlin, 26 June, 1905 (W. E. B.); New Haven, 6 July, 1904 (H. L. V.); Southington, 5 July, 1905 (B. H. W.); Easton, 19 June, 6 July, 1922 (P. G.). Common throughout the State.

New England.—June 3-September 6.

Libellula pulchella Drury

Illustration of Natural History, 1: pl. XLVIII, f. 5: 1773.

Nymph.—Color dark brown; general shape the same as *Platthemis* (Pl. iv, Fig. 7).

Head: labium with 12 to 13 mental setae; distal margin with about 15 small spinules, the margin serrate between each, there being for the most part more than one serration except for those nearest the point of articulation of the labial palpi; lateral setae of the palpi 9 with a smaller one (sometimes 2) at base just beyond the point of articulation and a group of minute ones (8-9) mesad of these; 10 to 11 notches present in the distal margin, the teeth each with 4 heavy setae except the two teeth alongside the movable end hook, the heavy setae in a graded series.

Abdomen: lanceolate with dorsal setose hooks on segments 4, 5 and 6, and a low elevation on 7; 8 and 9 without dorsal hooks of any kind, but the long marginal setae are grouped together at the point where these hooks occur in other species; lateral keels provided with short spines and longer setae, and the dorsal surface of the median terminal appendage also setose; lateral spines present on segments 8 and 9; lateral appendages less than half the length of the inferiors.

Measurements: total length, 24-27 mm.; length of abdomen, 15 mm.; width of abdomen, 7.5-9 mm.; length of the hind femora, 6 mm.; length of the median lobe of the labium, 4.5-5 mm.

Adult, male.—Color brown and buff or yellow.

Head: labium buff, labrum black or brown, clypeus and front dark brown, the vertex almost black, and projecting over the median ocellus in two distinct lobes; front wrinkled; occiput and postgenae dark brown, the postgenae with 2 to 3 yellow spots on each side behind the caudal margin of the compound eyes.

Thorax: dark brown, the dorsum somewhat lighter; prothorax brown, the caudal margin of the pronotum entire and with but few long hairs; legs dark brown to almost black, the femora each with ventro-lateral rows of heavy setae, flat beneath, and usually with a single dorsal carina; tarsal claws with a large ventral tooth placed considerably beyond the middle; wings with a basal elongated brown spot extending beyond the triangle, a nodal spot and a brown apex; anal angle and somewhat indefinite area between each brown spot, white; the white areas may, however, be entirely wanting; veins black; meso- and metathorax much darker on the sides and with two yellow or grayish stripes (which may be obscured in older specimens), one of which extends from the base of the hind wing to caudal margin of the mesokatepisternum; the other lies just above the lateral carina on the metepimerum; thoracic venter brown.

Abdomen: not compressed, gradually narrowed behind the third segment, with two buff or yellow stripes on terga above each lateral carina, extending from 1 to 8; yellow spots also on the terga below the lateral carinae on segments 2 to 8; remainder of the terga and venter dark brown to black; anal appendages black, the ventral surface of the superiors with about 12 small teeth; hamules (Fig. 63, No. 11) of the second segment with much reduced lateral lobes, but with large conspicuous mesal hooks; no ventral hooks on the first segment; the entire abdomen becomes bluish pollinose, obscuring the yellow marks.

Female.—The brown spots on the wing are usually smaller, but otherwise there is no important difference between the sexes; female appendages shown in Fig. 63, No. 3; lateral margins of the eighth terga produced ventrad.

Measurements: total length, male 55-57, female 47 mm.; length of abdomen, male 32-33, female 27-29 mm.; length of hind wing, male 41-44, female 36-39 mm.; width of hind wing, male 12-13, female 11 mm.; length of stigma, male and female, 5-5.5 mm.

The female is very similar to the female of *P. lydia*, but the structure of the venter of segments 8 and 9 is considerably different (Fig. 63, Nos. 2, 3), and the body is longer. Both *L. pulchella* and *P. lydia* become pollinose with age so that color characters of the body are not distinct.

Connecticut.—Whitneyville, 18 July, 1904 (P. L. B.); New Haven, 20 July, 1904 (B. H. W.), 27 June, 1905 (W. E. B.); Branford, 21 June, 1904 (H. L. V.); West Haven, 29 June, 1905 (W. E. B.); Cornwall, 10 August, 1918 (K. F. C.); Durham, 15 June, 1919 (M. P. Z.); New London, 15-22 June, 1921 (R. H. H.); Hamden, 30 May, 1922 (P. G.). Common throughout the State.

New England.—May 30-September 8.

Libellula quadrimaculata Linnaeus

Systema Naturae, 1: 543: 1758.

Nymph.—Similar in form to other *Libellulas*; labium with 7 lateral setae on palpi, and 11-12 notches in the mesal margin; mental setae about 13, the distal margins with a number of serrations between each marginal spinule.

Abdomen with dorsal setose spines or hooks on segments 4 to 8 inclusive, the spines themselves hidden among the setae; lateral spines of 8 and 9 short, incurved.

Measurements: total length (exuviae and mature nymph), 25 mm.; length of abdomen, 14-15 mm.; greatest width of abdomen, 7 mm.; length of hind femora, 6 mm.

Adult, male (Pl. XXI, Fig. 4).—Color brown and black.

Head: labium light brown or yellow with a black median stripe which extends over the mentum, entirely covering it; labrum brown with a black ventral margin; clypeus and front brown, vertex somewhat darker and concave at tip; occiput and postgenae black with two yellow spots on each side behind the caudal margins of the compound eyes.

Thorax: prothorax brown, the caudal lobe entire and provided with a fringe of hairs; meso- and metathorax olive-brown and yellow with the mesopleural and metapleural sutures darker, the dark stripes widened just behind the two katapisterna, and both connected with a dark triangle just behind the mesocoxae; legs dark brown or black, claws lighter and much wider proximad of the ventral tooth than beyond it; wings each with a nodal spot, not extending caudad of R; front wings with clear yellow from base to beyond arculus, sometimes to stigma; the hind wings, also with clear yellow from base to tip of triangle and along the costal border; cubito-anal cell, triangle, and a somewhat triangular area behind extending half way to the anal angle, dark brown to nearly black; membrane nearly white, antenodal cross-veins yellow.

Abdomen: densely pilose, the third segment only with a transverse median carina; color dark brown to black, segments 1-5 lighter, 5-10 darker; the terga 5-9 with buff-colored dashes just above the lateral carinae; ventral surface of terga 4-8 with a pale spot on each side; anal appendages brown, the superiors about twice as long as the inferior; hamules of the second segment composed of a pair of large mesal-hooks and a much reduced lateral lobe directed caudad.

Female.—Ventral margins of abdominal segment 8 leaf-like, projecting ventrad. The entire costal area of the wings is chlorinate in the female.

Measurements: total length, male 44, female 43 mm.; length of abdomen, male 24, female 27 mm.; length of hind wing, male 34-35, female 33-36 mm.; width of hind wing, male 10-11, female 11 mm.; length of stigma, male 3.5, female 4 mm.

The genitalia of both sexes are different from all other *Libellulas*, but the figuration of the wings should enable any one to distinguish the species. The abdomen is setose in contrast with other members of this genus.

Connecticut.—Hamden, 30 May, 19 June, 1922, 15 June, 1923 (P. G.); Storrs, 25 May, 1923, J. Cronin.

New England.—May 19-August 15.

Libellula semifasciata Burmeister

Handbuch der Entomologie, 2: 862: 1839.

Adult, male (Pl. XXI, Fig. 9).—Color brown to black, and yellow.

Head: labium, labrum, clypeus and front usually yellow but often assuming an orange tint; vertex brown and feebly concave, yellow or orange at tip; occiput and postgenae almost entirely yellow.

Thorax: prothorax brown, the caudal margin of the pronotum entire and with short hairs; meso- and metathorax dark brown to yellowish green, the dorsum slightly darker, young individuals having a poorly defined whitish stripe on the mesepimera, and the entire epimera yellow; older specimens with these marks obscured; the lateral carinae, however, between metepimera and thoracic venter is nearly always yellow; legs with brown to olive-colored coxae, trochanters and front femora, the middle and hind femora about half brown; tibiae and tarsi black, the tarsal claws with ventral teeth beyond middle, the proximal portion of the claw thicker than the distal; wings with much yellow, especially at base, where it covers the entire wing to the triangle: veins mostly brown or yellow; front wing with area between the sectors of the arculus and between Cu and A proximad of triangle, dark brown, in the hind wings including also the triangle, supertriangle, both cubito-anal cells, and a small area behind these; both wings with a nodal spot, half the width of the wing and the apex from proximal margin of the stigma, dark brown, the area beyond the distal margin of the stigma much lighter in color; membrane white to gray.

Abdomen: brown and black, the proximal segments somewhat greenish. The following portions are black: dorsum of the first tergum, an obscure dark apical spot on 5, and a black mid-dorsal stripe from 5-10, widened on apical and proximal margins of

terga 6-8; venter of all terga entirely pale yellowish green; surface of abdomen smooth; anal appendages dark brown, the superiors slightly longer than the inferior; hamules (Fig. 63, No. 7) of the second segment with a flattened area beneath, conspicuous mesal hooks and small lateral lobes extending caudad; transverse median carinae on terga 2 and 3, that on 2 interrupted in middle.

Female.—With brown of the apex of the wings reduced to a transverse band about the width of the stigma, lateral margins of eighth terga produced ventrad.

Measurements: total length, male 44-48, female 43 mm.; length of abdomen, male 25-28, female 26 mm.; length of hind wings, male 35-39, female 35 mm.; width of hind wings, male 10-11, female 10 mm.; length of stigma, male and female, 5 mm.

Most closely related to *quadrifasciata*, from which, however, it may be distinguished by the wing characters. It is a rather common species throughout Connecticut.

Connecticut.—New Haven, 20 July, 1905 (B. H. W.); Branford, 21 July, 1920 (P. G.).

New England.—June 2-August 16.

Libellula vibrans var. *vibrans* Fabricius

Entomologiae Systematicae, 2: 380: 1793.

Adult, male (Pl. XXI, Fig. 8).—Color largely brown to black.

Head: labium yellowish buff, though somewhat darker on the meson and in front: labrum yellowish buff, clypeus and front to near ocelli, greenish white; vertex black, projecting over the median ocellus, the tip truncate and concave when viewed from above; occiput and postgenae black, the postgenae with two large yellow spots on each side behind the lateral margins of the compound eyes.

Thorax: prothorax uniform dark brown, the caudal margin of the pronotum entire and with but few hairs; meso- and meta-thorax dark brown, lighter on the sides, being a sort of olive color in the specimen at hand; shoulders of the epimera almost black, venter olive color; legs, with coxae and trochanters, nearly all of the front femora, middle femora at base, and half the hind femora brown, the remainder of the legs black; tarsal claws with ventral tooth considerably beyond the middle, the proximal portion of the claw thicker than the distal; wings with basal streak of brown between Sc and R, extending from base to shortly beyond the arculus, a small spot occupying all or part of the first postnodal cell, and the apical margins with a touch of brown; membrane of the hind wings brown; stigma black.

Abdomen: brown to black above, olive-colored below, the segments toward the tip darker; anal appendages black, the superiors only about one-third or one-fourth longer than the inferior;

hamules of the second segment composed of large curved mesal hooks and lateral lobes in the form of a rather wide ridge on the side of the latter; surface of abdomen almost or quite free from hairs, terga 2 and 3 with transverse ridges.

Female.—Lateral margins of the eighth terga projecting ventrad in a wide thin plate; sides of thorax and abdomen yellow to greenish; femora with basal half or a little more, yellow; tips of wings sometimes to the distal ends of the stigma, brown.

Measurements: total length, male 60 mm.; length of abdomen, male 38, female 37-38 mm.; length of hind wings, male 45-50, female 45-49 mm.; width of hind wing, male 12, female 13.5 mm.; length of stigma, male 6, female 6.5-7 mm.

There are two other recognized varieties, *vibrans axillena*, and *vibrans incesta* (Pl. XXI, Fig. 2), the former differing from *v. vibrans* (Pl. XXI, Fig. 8) only in having the front, clypeus, and labrum black instead of light-colored. *V. incesta*, however, is smaller in size and the entire body is bluish pollinose in older specimens. The wings also lack brown marks at the nodus, but the tips of the wings are sometimes brown and there is sometimes a basal streak. The face is yellowish, somewhat brownish above in *incesta*. The forms *v. vibrans* and *v. axillena* have been considered as separate species by many authors, but there is apparently no difference in the genitalia of the different varieties.

L. vibrans axillena has a costal streak of dark color between nodus and stigma. The measurements of the variety *incesta*³² are given below.

Total length, male 52 mm.; length of abdomen, male 30 mm.; length of hind wings, 39 mm.; width of hind wings, 11 mm.; length of stigma, 5 mm.

The nymph of *incesta* has been described by Byers (Ent. News, 38: 113: 1927) and is apparently closely related to *auripennis*, differing from that species in the characters of the key, and also in the lateral spines of segments 8 and 9, which are more incurvate.

Connecticut.—East Haven, 9 July, 1908 (B. H. W.) *var. vibrans*; Guilford, 13 July, 1920 (P. G.) *var. incesta*.

New England.—July to September.

Genus *Platthemis* Hagen

Nymphs.—Head with 10 lateral setae on the palpi, and about 8 mental setae. Abdomen with rudimentary dorsal hooks on segments 3-5, and small lateral spines on segments 8 and 9; anal appendages not decurved, the laterals about half the length of the inferiors.

Adults.—Wings with more than 10 antenodal cross-veins; proximal and distal margins of the stigma parallel, more than 3

³² *Libellula vibrans* *var. incesta* Hagen. Synopsis of the Neuroptera of North America, 155, 1861.

times as long as wide, and supported by three or more cross-veins; triangle 3-sided, considerably farther distad in the front wings than in the hind; M_2 with a conspicuous bend about as far distad as the proximal end of the stigma; subtriangle present in the male (two cubito-anal cross-veins present); Cu_1 arising exactly from the caudal angle of the triangle in both wings; prothorax with the hind lobe entire, and almost without marginal setae; abdomen of the male with ventral hooks on the first abdominal sternum; transverse, median carinae on terga 2 and 3 (interrupted on meson on 2); general color brown and buff.

The habits of the only representative of this genus are essentially the same as those of *Libellula*.

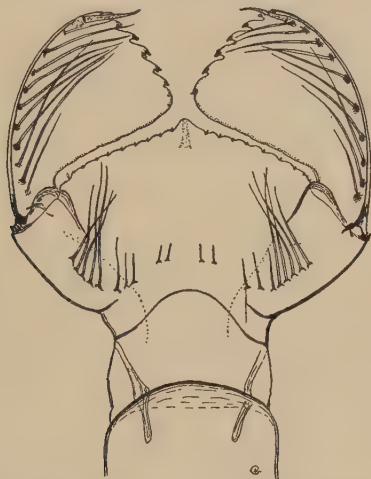


FIG. 64. Labium of the nymph of *Plathemis lydia*, greatly enlarged.

Plathemis lydia (Drury)

Illustrations of Natural History—Exotic Insects, 7: pl. XLVII, f. 4: 1773.

Nymph (Pl. IV, Fig. 7).—Color dark brown.

Head: labium (Fig. 64) with median lobe about as long as wide, the distal margin with shallow notches each containing a short spine, and with broad, shallow, rounded lobes between; a prominent lobe at the center of the distal margin. Mental setae 9 to 10; labial palpi with 10 lateral setae; distal margins of the palpi with six to seven teeth which are about as broad as long, each with one to three spines; front above the clypeus and labium when folded in place, densely hairy, the caudo-lateral surfaces of the head also setose.

Thorax: pronotum with broad rounded setose margins; propleura also hairy or setose; meso- and metapleura hairy; meso-

sternum with a short setose ridge in front of each coxa; legs hairy, the first two segments of the hind tarsi equal in length; wing-cases in full-grown nymphs extending to the seventh abdominal segment or caudal margin of 6, barely to 6 in some apparently full-grown specimens.

Abdomen: elongate; dorsal hooks present on segments 3-5 or 6 inclusive; 7-9 frequently hairy on dorsum but without hooks; lateral keels with short spines on segments 8 and 9, the spines about one-seventh as long as the segment (one-fourth in young nymphs) bearing them; lateral terminal appendages about half as long as the superior.

Measurements: total length, 21-23 mm.; length of abdomen, 11-13 mm.; greatest width, 7 mm.; length of metathoracic wing-cases, 5 mm.; length of hind femora, 4.5 mm.; length of median lobe of mentum, 3.5 mm.; width 1.5-4 mm.

A partly grown nymph has the following dimensions; total length, 13 mm.; length of abdomen, 8 mm.; greatest width, 3 mm.; length of metathoracic wing-cases, 1.5 mm.; length of hind femora, 5 mm.; length of medial lobe of mentum, 4 mm.; width 4 mm.

Adult, male (Pl. XXI, Fig. 1).—Color brown and buff, abdomen frequently pollinose.

Head: labium and labrum light brown, clypeus and front slightly darker, vertex and occiput still darker, approaching black; occiput with two to three yellow spots on each side near caudal margins of the compound eyes and two closely placed spots on the meson; front much wrinkled and vertex projecting over the median ocellus in two lobes.

Thorax: prothorax brown, caudal margin entire and with but few setae; remainder of thorax brown, with light-colored stripes from the base of hind wings to the mesokatepisternum, and another just above the lateral carinae on the metepimera; dorsal half of the mesokatepisternum pale; thoracic venter, brown; legs brown, the femora conspicuously flattened beneath, the latero-ventral margins both with heavy setae on all; front coxae flattened and with a fringe of hairs on the mesal margins; front and middle femora with two dorsal carinae each; tarsal claws much thickened at base, each with a lateral puncture, the ventral tooth beyond middle of the claw; wings with a brown dash between subcosta, tip of triangle and cubitus, and a wide cross-band beginning at the nodus and extending to the middle of the stigma.

Abdomen: depressed, not compressed, the segments gradually narrowed behind the third, color brown becoming pollinose; light-colored spots on terga 3-9 just above the lateral carina; venter brown, the first segment with two hooks; hamules (Fig. 63, No. 12) consisting of a broad lateral lobe and mesal hook separated by a shallow rounded notch.

Female.—The wings differ from those of the male in having a brown apex and nodal spot instead of the broad median band. The yellow of the abdomen is continued onto the second abdominal terga, the light spots of 2, 3 and 4 being more or less continuous. Female appendages (Fig. 63, No. 2) consisting of two widely separated lobes on the caudal margin of segment 8, and two small tubercles on the 9th sternum; width of abdominal segments 1-8 equal, 9 and 10 greatly narrowed.

Measurements: total length, male 45, female 42 mm.; length of abdomen, male 25, female 25 mm.; length of hind wing, male 30, female 33 mm.; width of hind wing, male 9-10, female 10-11 mm.; length of stigma, male and female, 4 mm.

Very similar in general appearance to *Libellula pulchella* Drury, but smaller in size. The male differs in wing coloration and structure of the first abdominal sternum. The female is much shorter and broader than *pulchella* and the sternum of segments 8 and 9 serve to distinguish it.

Connecticut.—Branford, June, 1905 (H. W. W.); East Haven, 19 June, 1908 (B. H. W.); Hamden, 19 June, 1922 (P. G.); Mansfield, May, 1923 (L. B. P.).

New England.—May 10-September 23.

Tribe PALPOPLEURINI Tillyard

A tribe represented in New England by a single genus. The nymphs possess a dorsal hook on abdominal segment 9 which distinguishes them from other tribes. The adults are small species, though usually very active; the wings of the two sexes are different (see Pl. XIII, Figs. 2, 4), and are less than 20 mm. in length.

Genus *Perithemis* Hagen

Nymphs.—Head: labium with setiform movable hooks; five lateral and nine mental setae. Abdomen with dorsal hooks on segments 3-9, and lateral spines on segments 8 and 9; superior anal appendages not decurved.

Adults.—Wings with less than ten antenodal cross-veins in the front wings; stigma more than three times as long as broad and supported by two to three cross-veins; triangle 3-sided, about as far distad in the hind wings as in the front; M_2 not sinuate; subtriangle absent in hind wings; Cu_1 usually arising exactly from the caudal angle in both wings; hind margin of prothorax bilobed and with long hairs; abdomen of male without ventral hooks on first segment; transverse median carina present on terga 3 and 4. General color brown and yellow, size small.

Our only member of the genus is a small but wary individual frequently seen skimming over the surface of ponds or lakes, alighting on reeds or projecting sticks, but keeping well beyond

reach at all times. It keeps near the surface of the water and is seldom seen except in sunny weather. The nymph crawls upon the bottom but is said to be a good climber (Needham, 1901).

Perithemis domitia (Drury)

Illustrations of Natural History—Exotic Insects, 2: pl. XLV, f. 4: 1773.

Nymph (Pl. IV, Fig. 3).—Head: labium (Fig. 65) with 7-9 mental setae, and 5 setae on the labial palpi; teeth of palpi fairly deep, each with one or two long spines and a shorter one alongside; dorsal surface of head behind the middle of the compound eyes uniformly setose, not ridged.

Thorax: hind femora extending to the seventh abdominal segment; wing-cases to the sixth.



FIG. 65. Labium of the nymph of *Perithemis domitia*, greatly enlarged.

Abdomen: heavy dorsal hooks on segments 3-9 inclusive, and lateral spines on segments 8 and 9; terminal appendages short, the laterals about half the length of the superior, the latter nearly as long as the inferiors.

Measurements; exuviae: total length, 14-15 mm.; length of abdomen, 8.5 mm.; greatest width of abdomen, 5 mm.; length of hind femora, 5.5 mm.

The length of the mentum is a distinguishing feature of this nymph, it being much shorter and the palpi proportionally longer than other genera and species. By referring to Fig. 65 it will be seen that the distance, B, from base of labial palpi to the base of the movable hook, is longer than the distance, A, to the base

of the mentum, and also longer than the distance from the articulation to the inner angle of the proximal segment of the palpi.

Adult, male.—Color brown and green, brown predominating.

Head: mouth parts, clypeus, labrum, front, vertex and occiput brown, with black or dark brown hairs; clypeus, labrum and front usually paler.

Thorax: uniform brown, with a dark greenish area cephalad of the mesothoracic spiracle and a similar one caudo-ventrad of it; caudal margin of prothorax bilobed, with long silken hairs; legs brown; femora with 3-7 black, heavy setae on the cephalo-ventral angles, and only an occasional one on the caudo-ventral angles, the remaining setae being weaker and brown in color; tarsal claws with ventral teeth almost at tips; wings uniform brown, transparent and without darker spots (Pl. XIII, Fig. 4).

Abdomen: uniform brown.

Female.—Head similar to that of the male; thorax similar except the wings, which are marked as in Pl. XIII, Fig. 2; abdomen also similar; female appendages short, about one-third as long as 9, and with a shallow emargination between.

Measurements: total length of male 25, female 20 mm.; length of abdomen, male 15, female 15 mm.; length of hind wings, male 18-20, female 19 mm.; width of hind wings, male 6-7, female 6-7 mm.

A dimorphic species of rather common occurrence. It is one of the smallest of our dragonflies (Anisoptera).

Connecticut.—Whitneyville, 26 July, 1905 (P. L. B.); New Haven, July, 1905 (I. B. D.), 25 July, 1905 (W. E. B.); West Thompson, 12 July, 1905 (H. L. V.); Guilford (Pistapaug Pond), 8 July, 1921 (P. G.).

New England.—June 8-September 5.

Tribe BRACHYDIPLACINI Tillyard

Only one representative occurs in New England—*Nannothemis*. The nymphs are not easily separated from other tribes, but the superior terminals are as long as the inferiors and the lateral spines are incurved. The adults have the anterior margin of the front wings broken as in Pl. XII, Fig. 2, a character present in no other Libellulid occurring in this region.

Genus *Nannothemis* Brauer

Nymphs.—Head with six lateral setae on the palpi, and about 10 on the mentum; abdomen without dorsal hooks, the lateral spines of segments 8 and 9 similar in size and much shorter than either segment; anal appendages not decurved.

Adults.—Wings with considerably less than 10 antenodal cross-veins in both wings; stigma with parallel proximal and distal margins, less than 3 times as long as wide and supported by two

cross-veins; triangle 4-sided in the front wings; M_2 not sinuate; subtriangle absent; Cu_1 arising exactly from the caudal angle of the triangle in both wings; triangle of the hind wings nearly as far distad of the base as in the front wings; hind margin of pronotum entire, and with a few short hairs; male without ventral hooks on the first abdominal segment; transverse median carina present only on the third tergum; general color, male black, female black and yellow.

Nannothemis bella Uhler

Proceedings of the Academy of Natural Sciences of Philadelphia, 87: 1857.

Nymph.—Head: labium with 11 to 12 mental setae and 6 lateral setae (one additional minute seta at base); palpi with shallow teeth, each tooth with one to two spines; eyes projecting well forward, their margins viewed from above about as far cephalad as any portion of the front or mouth parts.

Thorax: legs short, the hind femora extending to the middle of the abdomen.

Abdomen: without dorsal hooks or conspicuous elevations; small lateral incurved spines on segments 8 and 9; segment 9 with long setae on caudal margins, extending beyond the terminal appendages; superior and ventral appendages nearly equal in length, the laterals about three-fourths as long.

Measurements: total length, 8.5 mm.; length of abdomen, 4 mm.; length of hind femora, 2.25 mm.; width of head, 2.5 mm.; width of abdomen, 3 mm.

Described from a nymph obtained from Dr. Calvert labeled "*Nannothemis bella* (Uhler) Weith det. Simonton Lake, Elkhart, Indiana 5/26/1901."

Needham's³³ measurements are as follows: total length, 10 mm.; abdomen, 5.5 mm.; hind femur, 3.5 mm.; width of head, 3.5 mm., of abdomen, 4 mm.

Adult, male.—Color largely black.

Head: labium and labrum jet-black; clypeus black except the lateral angles, which are white; front with a black oblong spot above the fronto-clypeal suture, a transverse area immediately in front of the ocelli and the lateral margins also black, the remainder white; vertex metallic green; occiput with two small white spots near the dorsal margin between the compound eyes, the remainder, and also the postgenae, black.

Thorax: pronotum black, the caudal margin entire, and with very few hairs; meso- and metathorax uniform black, shining (pruinose with age), the hairs nearly white; legs entirely black; wings as in Pl. XII, Fig. 2.

Abdomen: black, without pale marks of any kind, slightly con-

³³ N. Y. State Museum, Bulletin 47: 511: 1901.

tracted behind segment 3; male appendages of segment 2 composed of a very large genital lobe, and the two arms of the hamule widely separated and pointed. Superior anal appendages brown at tips, small and with a few minute teeth on ventral surface near apex.

Female.—Differs from the male in having the sides of the thorax yellow, a yellow stripe on anepisternum of mesothorax; abdominal segments 2-4 with transverse yellow stripe, entire dorsum of 10, and basal spots on 5-7 yellow. The wings are yellowish on their proximal half or third.

Measurements: total length, male 16-21, female 19 mm.; length of abdomen, male 13, female 11-14 mm.; length of hind wings, male 14-16, female 14-16 mm.; width of hind wings, male 6 mm.

The black area on the front is variable and is not always quadrangular. This is our smallest species of Anisoptera.

Connecticut.—New Haven, 14, 18, 20 July, 1908 (B. H. W.).

New England.—June 7-July 29.

Tribe SYMPETRINI Tillyard

The nymphs of this tribe are of moderate size and the labia are of the typical form figured for *Sympetrum*, Pl. VII, Fig. 4. Adults lack the bend in M_2 seen in the Libellulini, have entire triangles in the front wings and are never dimorphic in wing coloration; the wings at base are never greatly widened and never reach 15 mm. in width in our species.

Key to Genera

Nymphs

1. Abdomen without a lateral spine on abdominal segment 8 **Erythemis**, p. 264
- Abdomen with a lateral spine on abdominal segment 8 2
2. No dorsal hooks on abdomen 3
- Dorsal hooks present on middle abdominal segments 4
3. Prominent bunches of setae on dorsum of segments 4 to 9 **Erythrodiplax**, p. 262
- No prominent bunches of setae on dorsum of segments 4 to 9 .. **Pachydiplax**, p. 277
4. Dorsal abdominal hooks usually as long as the segments bearing them; abdomen with a dorsal spine on segment 3³⁴ **Leucorrhinia**, p. 278
- Dorsal abdominal hooks shorter than the segments bearing them; without a spine on segment 3 5
5. Lateral spines of the abdomen long and straight; extending to the tips of the inferior appendages or beyond **Celithemis**, p. 284
- Lateral spines short and incurved **Sympetrum**, p. 266

Adults

1. Cu_1 arising exactly from the caudal angle of the triangle in the hind wing (Pl. XIV, Fig. 3) 2
- Cu_1 not arising exactly from the caudal angle of the triangle in the hind wing (Pl. XIV, Fig. 1) 4

³⁴ A few species of *Leucorrhinia* do not have this spine; these do not, however, occur in Connecticut.

2. Wings with large well-defined spots of brown; cells of anal loop 18-20 in number; more than 20 cells between M_2 and R_s beyond the oblique vein (Pl. XIII, Fig. 1) **Celithemis**, p. 284
 Wings without well-defined spots, if with brown areas, the latter more or less diffused over the base of the wing, or sometimes with small, nearly black areas at extreme base; cells of the anal loop 8-13 in number; cells between M_2 and R beyond the oblique vein less than 20 3
3. Face white; predominant color of thorax and abdomen black; (tenerals have the thorax dark brown and abdomen black); base of hind wings with a small triangle of black (Pl. xv, Fig. 4) .. **Leucorrhinia**, p. 278
 Face buff or yellow; predominant color of thorax and abdomen brown and red, or olive and buff, never black; base of hind wings without a small triangle of black (Pl. xiv, Fig. 3) **Sympetrum**, p. 266
4. Spines of hind femora suddenly enlarged near the apex, the last 3 or 4 much longer than the proximal ones and farther apart; antenodal cross-veins of the front wing 10 or more (Pl. xx, b) **Erythemis**, p. 264
 Spines of hind femora gradually lengthened from base to tip, the last 3 or 4 not greatly longer than those immediately proximad; antenodal cross-veins of front wings usually less than 10 5
5. Width of the venter of abdominal segment 5, 2 mm. or more; stigma with 1 or no cross-veins behind it (Pl. xiv, Fig. 1) .. **Pachydiplax**, p. 277
 Width of the venter of abdominal segment 5 less than 2 mm.; stigma with two or more cross-veins behind it (Pl. XIII, Fig. 3) **Erythrodiplax**, p. 262

Genus *Erythrodiplax* Brauer

Nymphs.—Labium with setiform movable hooks; 9 lateral and 13 mental setae; abdomen without dorsal hooks, but with lateral spines on segments 8 and 9; superior anal appendages not decurved.

Adults.—Wings with less than 10 antenodal cross-veins, usually 7-10; distal and proximal ends of the stigma parallel, more than three times as long as wide, and supported by two to three cross-veins (usually two); triangle 3-sided, considerably farther distad in the front than in the hind; M_2 not sinuate; Cu_1 not arising from the caudal point of the triangle in the hind wings; subtriangle absent; hind margin of the pronotum bilobed and with long marginal setae. Abdomen much compressed, the male without ventral hooks beneath on segment 1; transverse median carinae on segments 1, 2 and 3; general color black and yellow.

Erythrodiplax berenice Drury

Illustrations of Natural History—Exotic Insects, 1: pl. XLVIII, f. 3: 1773.

Nymph.—Head: caudo-lateral angles rounded, the dorsum behind the eyes with six longitudinal setose ridges, between which are smooth areas; labium with 9-10 setae on the labial palpi, and 12-13 mental setae (Pl. VII, Fig. 2), a group of minute setae at base five or six in number.

Thorax: pronotum with a low setose prominence at middle.

Abdomen: dorsum with a faint brown stripe on either side, without dorsal spines but with elevations or prominences each armed with a group of heavy setae; lateral spines of segments 8 and 9 straight, that of 9 hardly as long as segment 10; lateral terminal appendages about three-fourths as long as the superior, which in turn is about four-fifths as long as the inferiors.

Measurements: length of metathoracic wing-cases, 5 mm.; width of head, 4 mm.; length of median lobe, 3 mm.; width 3 mm.

Described from a reared exuviae obtained from Dr. Calvert, labeled "*Micrathyria berenice* Viereck, presumably from Cape May region, New Jersey,"

Adult, male.—Color black and yellow.

Head: black with yellow spots on the lateral lobes of the labium, one on each side of the clypeus extending dorsad slightly onto the front, and two small spots (sometimes united) on each side just behind the compound eyes. Vertex and remainder of the front metallic blue, the vertex evenly rounded at apex.

Thorax: black, sometimes with yellow spots above the middle and hind coxae and on the metepimera; legs black, the procoxae considerably flattened, the mesal margins forming a sort of ridge provided with setae; wings as in Pl. XIII, Fig. 3, the brown spot over the nodus usually lacking in this sex.

Abdomen: black with yellow dashes on the sides of terga 3 or 4-7; black appendages of the second segment composed of long auricles, the hamules with a spine-like inner lobe and a flat, obliquely truncate outer one.

Female.—Color yellow and black.

Head: labium yellow with a black mesal line; labrum yellow, its ventral border black; clypeus yellow; front yellow with a transverse black line above the suture, upturned at either end, and connecting on meson with a somewhat triangular black area extending ventrad from the ocelli; vertex black, with a large oval yellow spot above; occiput and postgenae black, with 3 yellow spots on each side behind the caudal margins of the compound eyes; occiput with a pair of closely placed yellow spots on the meson.

Thorax: prothorax black with the following yellow: caudal lobe of notum except lateral angles, an inverted W-shaped mark on median lobes, cephalic margin and two small dots on each side just above the coxae. Meso- and metathorax yellow with about seven oblique longitudinal black lines on either side of the dorsal carina, which is also black; these lines present a wavy appearance and the first four are connected behind; coxae and trochanter and venter of the front femora pale, remainder of the legs black; wings clear yellow at base and with a brown area over the nodus which is extended in some individuals to occupy the greater part of the wing.

Abdomen: black and yellow, yellow as follows: a broad dorsal stripe from 1-7 occupying half the terga on each side, spots below the lateral carinae on 2 and 3, two small spots on eighth dorsum at base and all of tenth dorsum; ovipositor composed largely of the projecting eighth sternum.

Measurements: total length, male 34, female 32-35 mm.; length of abdomen, male 21-23, female 21-23 mm.; length of hind wing, male 23-24, female 23-26 mm.; width of hind wing, male 8, female 8-9 mm.

There is a great deal of variation in the amount of yellow on the body and brown color in the wings. The males are mostly black and without brown in the wings, but females may be found showing nearly all stages between the light-colored female as described, and the black male.

Inhabits salt marshes along the sea shore.

Connecticut.—Short Beach, 19 July, 1904 (P. L. B.); Stonington, 6 July, 1900 (J. A. H.); Stratford, 29 June, 21 July, 1908 (W. E. B.), 9 July, 1920 (P. G.).

New England.—June 21-August 28.

Genus *Erythemis* Hagen

Nymphs.—Labium with about 13-15 mental setae in full-grown nymphs; 8 lateral setae on the palpi; abdomen without dorsal hooks or lateral spines, though sometimes a trace on segment 9; anal appendages strongly decurved.

Adults.—More than ten antenodals in the front wing; proximal and distal margins of the stigma parallel, the latter supported by two cross-veins: triangle three-sided, only slightly farther distad in the front wings; M_2 not sinuate; subtriangle absent; Cu_1 not arising exactly from the caudal angle of the triangle in the hind wings, but from the distal side; hind margin of the pronotum bilobed; male without hooks on the venter of segment 1; transverse median carina on segments 2 and 3; general color green and black, or bluish.

The adults of this genus are strong fliers, and the nymphs may be found in small ponds or lakes.

Erythemis simplicicollis (Say)

Journal of the Academy of Natural Sciences of Philadelphia, 8: 28: 1830.

Nymph (Pl. iv, Fig. 1).—Color light brown (alcoholic specimens), usually greenish when fresh.

Head: mentum (Fig. 66) as broad or a little broader than long, the cephalic margin projecting strongly between the palpi; in full-grown specimens with 13-15 mental setae; in younger (6 mm. long) specimens 10-11; labial palpi with 8 lateral setae in older, 6 in younger specimens, the distal margins of the palpi without visible teeth but with groups of spines, the mesal margin

also with spines arranged in an irregular row; distal margin of mentum spinose; antennae with third, fifth, and sixth segments longest and subequal; others shorter; the caudal margin of the eyes viewed from above are about the middle of the lateral margins of the head; dorsal surface of the head behind the eyes with 6 longitudinal setigerous stripes in older nymphs.

Thorax: pronotum sloping cephalad sharply from the spiracles and with a setose elevation on meson just behind the middle; lateral margins of pronotum also setose; femora with a few scattered heavy setae on dorsal surfaces and at apices, the tibiae

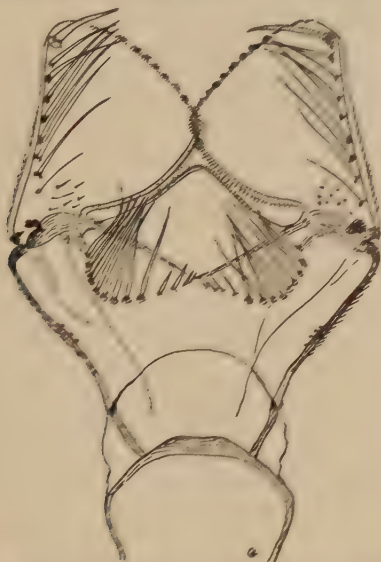


FIG. 66. Labium of the nymph of *Erythemis simplicicollis*, greatly enlarged.

also with heavy setae; tarsi with claws about as long as the first segment; wing-cases in older specimens reaching to the middle of the seventh abdominal segment (in alcoholics, to segment 9); venter of thorax with a conspicuous setose ridge on mesosternum just behind the first coxae.

Abdomen: ovate; the lateral keels without spines or with rudimentary ones, more frequently without; terminal appendages broad at base, the superior and ventral nearly equal in length, laterals one-half as long as the superior in full-grown, less than one-third as long in younger nymphs.

Measurements: total length, 15-16 mm.; length of abdomen, 8 mm.; length metathoracic wing-cases, 5-6 mm.; length hind femora, 4.5-5 mm.; length median lobe, 4 mm.; width, 1.5-4 mm.

Measurements of a young nymph: total length, 4 mm.; length of abdomen, 2 mm.; greatest width, 2 mm.; length of wing-cases, .25 mm.; length of hind femora, 1.25 mm.; length of median lobe, 1.25 mm.; width, 1.2 mm.

Described from a series of nymphs obtained from Illinois State Natural History Survey through the courtesy of Dr. C. P. Alexander, and specimens taken in Connecticut in different localities. Easily recognized by its hunchback appearance.

Adult, male (Pl. xx, b).—Color green and black, the thorax and abdomen entirely bluish-pollinose, in older males.

Head: green, black or dark brown as follows: spot on labrum, mesal margins of the lateral lobes, cephalic surface of vertex, a narrow line between vertex and front, and two dark spots on the postgenae behind the caudo-lateral margins of the compound eyes.

Thorax: entirely green or bluish-pollinose, the green individuals, "frequently with dorsal carina antehumeral, humeral and two indistinct lateral lines and some marks near the coxae black";³⁵ prothorax with bilobed caudal margin, provided with a fringe of long hairs; legs black, the coxae and trochanters lighter; tarsal claws with a minute ventral tooth beyond the middle; front coxae flat with a dense fringe of hairs on the mesal ridge; wings clear, without opaque marks, slightly flavescent.

Abdomen: entirely bluish-pollinose, or green and black; terga 2 and 3 entirely green, 4-7 each with a black or brown spot occupying the caudal half of the dorsum; terga 8 and 9 and sometimes 10 entirely black; venter of abdomen brown; superior anal appendages green, about one-third longer than the inferiors; hamules of the second segment composed of a long, rounded, lateral lobe and a slender mesal hook not quite as long as the lateral lobe; abdomen with but few hairs except on terga 1 and 2, and on venter.

Female.—Lacks the dark marks on the thorax: superior anal appendages green; caudal margin of eighth sternum entire, projecting ventrad a distance equal to half the vertical diameter of the segment. Bluish or slate-colored forms do not occur in this sex; at least they have not been seen in Connecticut.

Measurements: total length, male 44, female 38-43 mm.; length of abdomen, male 27, female 23-28 mm.; length of hind wings, male 32, female 30-31 mm.; width of hind wings, male 9-10, female 9 mm.; length of stigma, male and female, 3-3.5 mm.

Connecticut.—East Haven, 16 August, 1906 (P. L. B.), 30 July, 1921; Hamden, 4 July, 1921, May, 1922 (P. G.).

New England.—May to September.

³⁵ Calvert. Trans. Am. Ent. Soc., xx: 265; 1893.

Genus *Sympetrum* Newman

Nymphs.—Head: movable hooks of palpi small, usually setiform; lateral setae 7-13; mental setae 11-17; abdomen ovate,

usually with dorsal hooks on segments 4-8 but sometimes entirely without (*corruptum*); lateral spines always on segment 9, usually also on 8, but absent in *corruptum* from this segment; superior anal appendages not decurved.

Adults.—Wings with less than ten antenodal cross-veins; distal and proximal margins of the stigma parallel, the latter three times as long as broad, and supported usually by only one or two cross-veins; triangle three-sided, considerably further distad in the front wing than in the hind; M_2 not sinuate; subtriangle absent; Cu_1 arising exactly from the caudal angle of the triangle in both wings; hind margin of the pronotum bilobed, and with long silken hairs; femora with one of the usual two ventral rows of heavy setae, greatly reduced, and usually wanting in the front femora; abdomen somewhat compressed behind the third abdominal segment, except in *corruptum*, the male without ventral hooks on segment 1; transverse median, dorsal carinae on segments 2, 3 and sometimes 4 (*corruptum*); general color brown, abdomen frequently red.

This genus is most closely related to *Pachydiplax*, *Leucorrhinia*, and *Celithemis*.

Adults of the genus are late summer fliers, frequently congregating in considerable numbers in sunny locations towards the end of the season. The nymphs are most frequent on vegetation in boggy ponds. The eggs are laid by dipping the abdomen while in flight.

For key to North American species (adults) see
Muttkowski, R. A. Bulletin of the Wisconsin Natural History Society
(2), 6: 108: 1908.

A synopsis of the nymphs has been published by
Walker, E. M. Canadian Entomologist, 49: 409-418: 1917: pl. XIX.

Key to Species

Nymphs³⁶

- | | | |
|----|--|--------------------|
| 1. | Segments 8 and 9 with lateral spines; dorsal hooks present | 2 |
| | Segment 8 without lateral spines, those of segment 9 vestigial; dorsal hooks entirely absent | 8 |
| 2. | Dorsal hooks on segments 6 to 8 (7-8 in one reared <i>vicinum</i>) as long as the segments which bear them, lateral spines of segments 8 and 9 subparallel, those of 9 as long as the lateral margins of the segment (not including spine) and reaching back as far as the tip of superior appendage; eyes prominent | 3 |
| | Dorsal hooks shorter than the segments which bear them; lateral spines more or less convergent, their outer margins continuing the general curve of the abdominal margins; those of segment 9 shorter than the lateral margins of the segment and not reaching as far back as tip of superior appendage; eyes moderately prominent | 4 |
| 3. | Lateral spines of segment 8 scarcely twice those of segment 9, two and one-half times as long as their basal breadth, outer margins of latter distinctly incurvate; lateral appendages half as long as the inferiors, the latter not acuminate | <i>semicinctum</i> |

³⁶ From Walker, E. M., Canadian Entomologist, 49: 410-413: 1917.

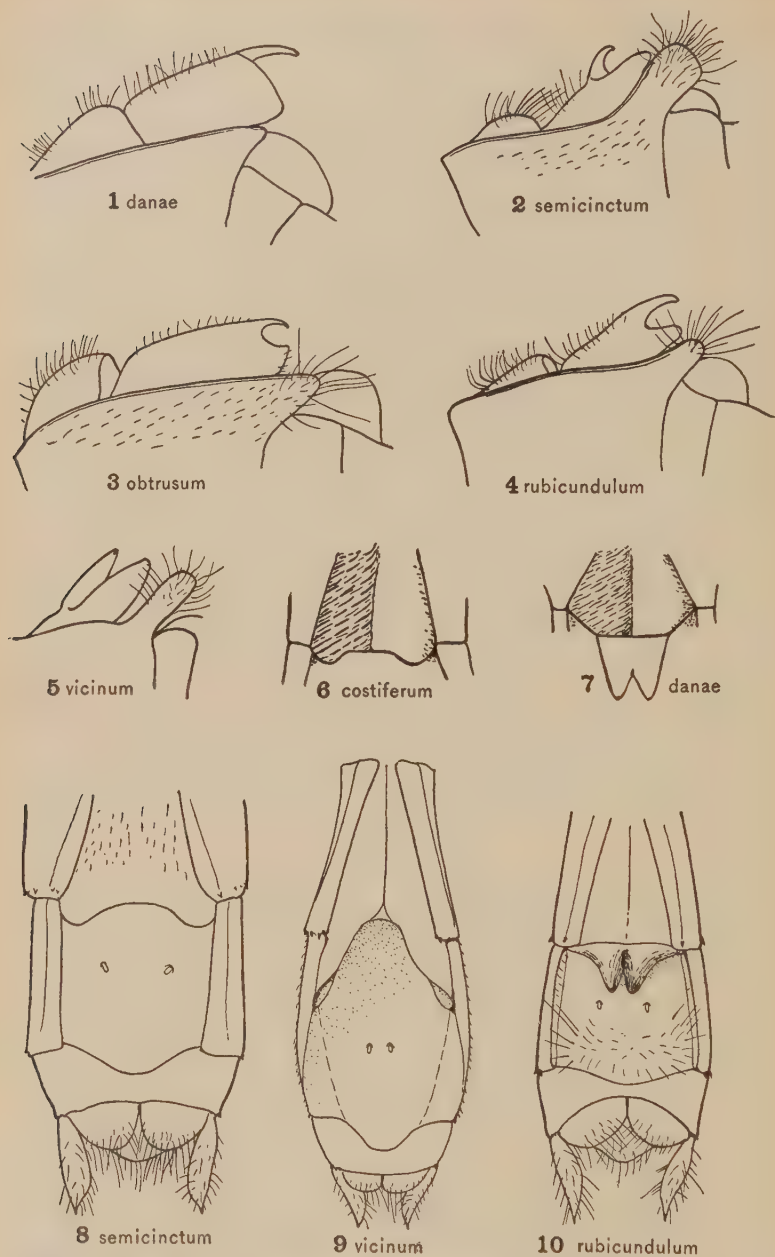


FIG. 67. Figs. 1 to 5, Accessory appendages of male. Figs. 6 to 10, vulvar lamina and terminal abdominal segments of female abdomen from below, greatly enlarged.

- Lateral spines of segment 8 more than twice, those of 9 three times as long as basal breadth, outer margins of latter nearly straight, lateral appendages less than half as long as the inferiors, the latter apically acuminatevicinum
4. Dorsal hooks well developed, slender and very acute, that of segment 7 nearly as long as the mid-dorsal line of the segment, that of 8 usually more than half as long as the segment 5
- Dorsal hooks smaller and when well developed somewhat stouter and distinctly curved, that of segment 9 distinctly shorter than the segment, that of 8 rarely half as long as the segment 6
5. Base of mentum of labium distinctly broader than the distance between middle coxae and somewhat more than one-fourth the greatest width; lateral spines of segment 9 usually at least half as long as lateral margins of the segments; lateral setae typically 11 (costiferum)
- Base of mentum of labium scarcely, if at all, broader than middle coxae and about one-fourth of the greatest width, lateral spines of segment 9 two-fifths to one-half as long as lateral margins of the segment; lateral setae typically 10 (pallipes)
6. Dorsal hooks present on segments 4 to 7 or 8, sometimes absent from segment 4 or 8, lateral spines of segment 9 about one-third as long as the lateral margins of the segment, lateral setae 9 to 11 7
- Dorsal hooks present on segments 5 to 7 only, vestigial, or absent altogether, lateral spines of segment 9 about one-fifth as long as lateral margins of the segment, lateral setae usually 11 rubicundulum
7. Lateral setae 11, dorsal hooks vestigial or absent from segments 4 and 8 danae
- Lateral setae 9 or 10, dorsal hooks somewhat larger, generally present, though small on segments 4 and 8 obtrusum
8. Lateral setae 9, mental setae about 13, 7 in the stronger, outer series (illotum)
- Lateral setae 13 to 14, mental setae about 17, 9 in the outer series corruptum

Adults, Males

1. Fourth abdominal terga with a transverse carina at middle corruptum
- Fourth abdominal terga without a transverse carina at middle ... 2
2. Sides of thorax marked with bright yellow danae
- Sides of thorax not marked with bright yellow; brown or red .. 3
3. Superior anal appendages with a sharply angled ventral tooth near the middle; hamules not divided proximad of the middle 4
- Superior anal appendages without a sharply angled ventral tooth near the middle; hamules divided far proximad of the middle .. 6
4. Legs black with exception of the ventral side of the front femora 5
- Legs pale yellowish with black spines ambiguum
5. Hamules with a deep notch (Fig. 67, No. 4) rubicundulum
- Hamules with a shallow notch (Fig. 67, No. 3) obtrusum
6. Hind wings chlorinated from base to nodus; front wings from bases to triangles, Pl. xxii, a semicinctum
- Hind wings not chlorinated from base to nodus nor the front wings from bases to triangles 7
7. Legs light brown to brownish red; stigma small (2 mm. long)... vicinum
- Legs dark brown to black; stigma 3 mm. in length (costiferum)

Females

1. Fourth abdominal tergum with a transverse carina at middle; thorax usually with two sub-circular yellow spots on each side
Fourth abdominal tergum without a transverse carina at middle; thorax without yellow spots on sides **corruptum** 2
2. Sides of thorax marked with yellow and black **danae** 3
3. Sides of thorax brown or red, sometimes shading into yellow 3
3. Sternum of abdominal segment 8 projecting ventrad and visible from the side, the apical margin nearly 1 mm. below the caudo-ventral angles of tergum 8 **vicinum**
- Sternum of abdominal segment 8 not projecting ventrad or visible from the side; the apical margin less than 1 mm. below the caudo-ventral angles of tergum 8 4
4. Vulvar lamina apparently invisible, there being no division between the plates and the caudal margin of the 8th sternum 7
- Vulvar lamina plainly visible, and a distinct division between the plates and the caudal margin of the 8th sternum 5
5. Legs pale yellowish brown, with black spines; vulvar lamina with an obtuse rounded median notch **ambiguum**
- Legs black except the ventral surfaces of the front femora; vulvar lamina with an acute median notch 6
6. Vulvar lamina less than half as long as sternum 9 **rubicundulum**
- Vulvar lamina more than half as long as sternum 9 **obtrusum**
7. Hind wings, and sometimes the front wings also, chlorinated to nodus **semicinctum**
- Neither front nor hind wings chlorinated to nodus (**costiferum**)

Sympetrum corruptum Hagen

Synopsis of the Neuroptera of North America, 171: 1861.

Adult, male.—Color, olive-green, yellow and black, or red and black.

Head: face, including labium, labrum, front and vertex, yellow, the front with a dark line in front of the ocelli; occiput and postgenae darker, with lighter spots near the margins of the compound eyes.

Thorax: dark green or yellow, the caudal lobe of the prothorax bilobed, and with long setae; mes- and metepimera with more or less faint bluish lines terminating shortly caudo-dorsad of the coxae in small bright yellow spots; tarsi and claws black, the claws with ventral teeth much shorter than half the length of the claw beyond the tooth; wings large, with little or no yellow at the extreme base; stigma brown in the middle and yellow on both ends; veins brown.

Abdomen: but little compressed behind the third segment, gradually tapering to tip; the terga with median transverse ridges on 2, 3, and 4; terga mostly brown or yellowish (becoming red) with pale yellow spots on the sides above the lateral carinae; the mid-dorsum of 8 and 9 with broad black dashes, and a much-reduced one on 10; venter black at bases of segments, the rest pale; superior anal appendages without a large tooth below, the ventral surface forming a fairly even curve with a few small teeth.

Female.—Similar in most points to the male except that the color of the abdomen does not become reddish and most of the other colors are retained longer; caudal margin of eighth sternum slightly excavated.

Measurements: total length, male 38-45, female 38 mm.; abdomen, male 25-27, female 24-26 mm.; hind wing, male 27-30, female 29-30 mm.; width hind wings, male 9, female 10-11 mm.

This species is so different from all other members of this genus that it would seem to belong elsewhere.

A single female collected by Mr. Walden at Lighthouse Point, June 10, 1906.

New England.—June 10-September 10.

***Sympetrum costiferum* (Hagen)**

Synopsis of the Neuroptera of North America, 174: 1861.

Adult, male.—Brown or red.

Head: front with two smoky spots; occiput pale with black spots behind the eyes.

Thorax: brown, wings flavescent along the costal margin; stigma yellow to brown, supported by one cross-vein; shoulders of mes- and metepimera sometimes black.

Abdomen: pale (brown or red) without dark triangles on the sides of terga, sometimes with a black line above lateral carinae and a trace on dorsal carina; inferior anal appendage with two upturned teeth at apex; superiors with four small teeth on ventral margins.

Female.—Venter of segment 8 does not project ventrad as in *vicinum* to which the species is most closely related.

Measurements: total length, male 32-36, female 35 mm.; length of abdomen, male 21-25, female 23-26 mm.; length of hind wings, male 25-26, female 25-28 mm.; width of hind wings, male 8-10, female 9-9.5 mm.

Specimens in the collection of Dr. P. P. Calvert, from South Dakota and Washington, are larger than Eastern examples.

New England.—July 12-October 7.

***Sympetrum danae* (Sulzer)³⁷**

Abgekürzte Geschichte, etc., 169 tab. 24, fig. 3: 1776.

Adult, male.—Color black and yellow.

Head: labium with a black spot on middle, pale on sides; labrum dark brown, clypeus yellow but showing a tendency to become brown; front yellow below and on sides, dark brown above; sometimes the entire face is brown; rear of head black with two yellow spots on each side behind the compound eyes.

Thorax: dark brown to black with yellow; mesepisterna with

³⁷ = *scoticum* (Donovan). British Insects 15: 523: 1811.

two yellow spots on the katepisterna, the anepisterna also with two small spots; mesepimera with a pale stripe from shoulders to wing bases a little wider cephalad; behind this stripe the thorax usually shows 6-7 yellow spots, those on the metepimera sometimes fused, forming a stripe; venter of thorax with 3 spots behind the metacoxae.

Abdomen: black, tergum 2 with four yellow spots, one on each lateral margin, and two on dorsum, 3 with six spots, three on each side, 4-9 inclusive, each with two yellow triangles, those on 9 small; anal appendages black; hamules (Fig. 67, No. 1) divided about half way to base, the mesal arm sharply pointed.

Female.—Face yellow, with a heavy, transverse black stripe on dorsum of front; abdomen with a black stripe along each side on terga 3-8 about 1 mm. wide; remainder of these terga pale; nearly all of 9 and 10 dark. Vulvar lamina as in Fig. 67, No. 7.

Measurements: total length, male 27-33, female 29 mm.; length of abdomen, male 18-24, female 19-24 mm.; length of hind wings, male 20-27, female 22-27 mm.; width of hind wings, male 7.5-8, female 8.5 mm.

Eight specimens examined from Scotland and one from New England in collection of P. P. Calvert; there are also several in the Yale University collection labelled Eastport, Maine, collected by S. I. Smith.

A variable species, especially in the color of the thorax and abdomen. The thorax is said to be almost black in some specimens.

***Sympetrum rubicundulum* (Say)**

Journal of the Academy of Natural Sciences of Philadelphia, 8: 26: 1839.

Nymph.—Color brown, or greenish in life.

Head: much broader than wide, the caudo-lateral margins with a few scattered, rather heavy setae; labrum pilose, labium triangular, with 9-10 lateral setae and a movable hook, closely resembling the lateral setae; the mesal and caudal margins of the palpi with short unequal spines but no teeth; distal margin of the mentum with about 7 short setae, there being 13-14 mentals on each side; distal margin with a projecting lobe at base of each palpus.

Thorax: pronotum flat, the lateral margins projecting but slightly and with a few setae; a bunch of setae just above the procoxae on the propleura; all femora with an irregular dorsal row of setae and a few scattered ventral ones of about the same length; tibiae with more or less scattered dorsal and ventral setae, the tarsi with the usual double row beneath; claws without teeth; wing-cases extending to middle of seventh or eighth abdominal segment in full-grown nymphs.

Abdomen: with flat venter; lateral keels of segments 1-6 with

very small setae, spines beginning on segment 8; small dorsal hooks present on segments 4-7, usually longest on 5 and 6, but never as long as the segments; anal appendages with laterals half as long as inferiors, the superior one-fourth longer, nearly as broad at base as the appendage is long; inferiors with short setae on sides and mesal surfaces and superior appendage with a few weak setae on dorsum and stronger ones on lateral margins.

Measurements: total length, 12-15 mm.; length of abdomen, 7-9 mm.; width, 4-5 mm.; length median lobe labium, 4 mm.; width, 3.75 mm.

Adult, male.—Color dark brown or red and black.

Head: labium, labrum, front and vertex to the antennae light brown or buff with almost black setae; front immediately cephalad of the antennae and along the margins of the compound eyes darker; occiput and postgenae brown; eyes greenish yellow below, brown above when alive.

Thorax: uniform brown, paler below and approaching a greenish yellow on the sides; pronotum with long silken hairs on the caudal margin, which is bilobed. Legs with brown coxae and trochanters, the femora and tibiae sometimes light below, black above (usually entirely black) tenebrals dark at tips, light at base; tarsi black, the claws each with a single ventral tooth, which is more than one-half the length of the claw beyond the base. Wings as in Pl. xiv, Fig. 3, chlorinate at base only.

Abdomen: brown, frequently conspicuously red, with terga 4-9 black above the lateral carinae; dorsum of segment 10 dark brown or red; abdomen considerably compressed beyond segment 3; anal appendages brown with a ventral projection about the middle, the latter showing a few small teeth; accessory genitalia as in Fig. 67, No. 4, the hamules much larger than the auricles.

Female.—Similar in most features except that the general color is much lighter and there is more black on the caudo-lateral angles of the abdominal terga, the black extending to the cephalic margins; two dashes each on the sides of the third and fourth terga; appendages as shown in Fig. 67, No. 10.

Measurements: total length, male 33-34, female 33 mm.; abdomen, male 21, female 21-33 mm.; length of hind wings, male 25, female 24-26 mm.; width of hind wings, male 9, female 9 mm.

There are two recognized varieties of *rubicundulum*,—*S. rubicundulum assimilatulum*, and *rubicundulum decisum*, the latter an essentially western form. Var. *assimilatulum* is said to be common in New York, and differs from the usual form in having the yellow color of the front wings extend to the nodus.

Connecticut.—South Manchester, 3 August, 1896 (W. C. S.); Westville, 28 August, 1901 (W. E. B.), 9 August, 1906 (P. L. B.); New Haven, 16 June, 1902 (E. J. S. M.), 12 August, 1902 (B. H. W.), 16 September, 1903 (W. E. B.), 16 October, 1903 (H. L. V.), 6 August, 1917 (M. P. Z.); Branford, 21 June, 1904 (H. L. V.); Short Beach, 14 July, 1904 (P. L. B.);

Westbrook, 30 August, 1904 (H. L. V.); Stonington, August, 1906 (J. A. H.); Storrs, 4 October, 1923 (J. Cronin). Common throughout the State.

New England.—June 9-October 9.

Sympetrum semicinctum Say

Journal of the Academy of Natural Sciences of Philadelphia, 27: 1839.

Adult, male.—Color buff to brown and red.

Head: Face including labium, labrum, clypeus, front, and vertex, brown, considerably darker in front of the antennae; vertex projecting over median ocellus in a single lobe, the apex lighter in color; occiput yellow, postgenae dark brown with yellow spots along the lateral margins behind the compound eyes.

Thorax: brown, the lateral and ventral surfaces slightly, if at all lighter; legs black except the coxae, trochanters and venter of first femora, which are dark brown; tarsi black, the claws having a tooth beneath which measures less than half the length of the claw beyond the tooth; base of fore wings yellow about half way to nodus from the base, the hind wings yellow to the nodus, and a darker crescent-like yellow area from the nodus to the anal angles.

Abdomen: dark red or brown with median transverse carinae on terga 2 and 3; terga 1 and 2 lighter brown, the lateral margins of 5-10 black, the black area on each side wider caudad; venter of 3-10 black; accessory genitalia as in Fig. 67, No. 2, the auricles not longer than the hamules; anal appendages only with small ventral teeth on the brown superiors near apex; inferior black.

Female (Pl. xxii, a).—Abdomen darker than the male, with black lateral margins on 2-10, the black spreading over the entire dorsum on 5-10 and sometimes enclosing small subcircular pale spots on 8 and 9, venter of abdomen mostly black; female abdomen shown in Fig. 67, No. 8.

Measurements: total length, male 30, female 27 mm.; length of abdomen, male 19, female 16 mm.; hind wings, male 21-23, female 20 mm.; width of hind wings, male 8, female 7-8 mm.

A rather common species distinguishable from most others of this genus by the great extent of the flavescent area of the base of the wings; from *S. rubicundulum assimilaturn*, its nearest ally, by the presence of a large median ventral tooth on the superior anal appendages of the male (in *assimilaturn*).

Western representatives of this species are much larger, the abdomen measuring as much as 26 mm., and the yellow color of the front wings sometimes reaching the nodus.

Connecticut.—Chapinville, 29 August, 1904 (W. E. B.); North Haven, 3 August, 1905 (H. L. V.); Manchester, 3 September, 1920 (P. G.); Guilford, 30 July, 1922 (W. E. B.).

New England.—June 29-October 5.

Sympetrum obtrusum Hagen

Stettiner Entomologische Zeitung, 28: 95: 1867.

Adult, male.—Color brown, red and yellow.

Head: face including labium, labrum, clypeus, front and vertex (except the black basal line surrounding the antennae) yellow; occiput and postgenae darker, with some yellow.

Thorax: uniform dark brown; the wings colorless, with a touch of yellow at base of hind wings; legs black, except the coxae, trochanters and ventral surfaces of front legs, which are dark brown; tarsal claws each with a tooth beneath, which is much less than half the length of the claw beyond the tooth.

Abdomen: dark brown or red, considerably contracted behind segment 3, and somewhat widened towards the tip; median transverse carinae on segments 2 and 3; caudo-lateral angles of the terga above the lateral carinae, black on segments 4-9, venter of abdomen dark brown; anal appendages brown, the superiors with a conspicuous, denticled ventral tooth on each; accessory genitalia of the second segment as shown in Fig. 67, No. 3.

Female.—This sex is said to be olive-brown in color with a reddish tinge.

Measurements: total length, male 33-37; abdomen, male 22-25, female 22 mm.; length hind wing, male 24-25, female 24 mm.; width hind wings, male 8, female 8.5 mm.

Calvert's measurements are as follows: abdomen, male 22-25, female 23.5-24 mm.; hind wing, male 21-25, female 23-25.5 mm.

A single male in our collection bears the label Westbrook, 30 Aug., 1904, H. L. Viereck. The only reliable means of distinguishing this species from *rubicundulum* lies in the shape of the hamules of the accessory genitalia. The female is apparently not distinguishable from *rubicundulum*. There are also two varieties of this species, but only the eastern variety, *S. obtrusum obtrusum*, is represented in our fauna.

New England.—July 3-October 5.

Sympetrum vicinum Hagen

Synopsis of the Neuroptera of North America, 175: 1861.

Nymph.—Head nearly twice as wide as long; the caudo-lateral angles rounded, and with rather long, heavy setae (.25 mm.); labium with 9 lateral setae on palpi, the mesal and caudal margins of proximal segment with setae, in pairs on mesal margin (one large and one small) but no teeth; movable hook similar to lateral setae; mentum with 11 setae each side (Needham, 12 or 13); the distal margin with about 5 very minute spines, and rounded lobes at the base of the palpi; palpi conspicuously spotted beneath; labium extending between second pair of legs.

Thorax: Prothorax with rounded, setose lateral angles, which

project slightly; and a bunch of setae above the procoxae; femora all with 3 rings of brown and long hair-like setae; tibiae with 3 dark rings each, the tarsi with darker tips and the claws entire; wing-cases extending to middle of abdominal segment 5 in exuviae; middle of 7 in alcoholics.

Abdomen: broad and flat below, with the segments dark-banded, and with lighter spots on the caudo-lateral angles of the segments 1-9; long lateral spines on 8 and 9, those on 9 reaching beyond the tip of the superior anal appendage, and with long lateral setae; lateral keels also with setae on segments 5-7, the proximal segments nearly or entirely free; spines on 8 and 9 black-tipped; anal appendages also black-tipped, the superior about one-third shorter than the inferiors, and the lateral appendages about half as long as inferiors; superior appendage with setose lateral margins and a few setae near tip of its dorsum; the inferiors, setose on all surfaces but with larger setae on the lateral margins.

Measurements: total length, 12-13 mm.; length of abdomen, 8 mm.; width of abdomen, 5 mm.; length metathoracic wing-cases, 4 mm.; length median lobe, 3-4 mm.; width median lobe, 3 mm.

Described from one exuviae from which an adult male was reared, several exuviae and one full-grown nymph.

Adult, male.—Color dark brown, sometimes red and yellow.

Head: buff to yellowish, labium and labrum yellow, clypeus buff; front, vertex and occiput darker brown.

Thorax: dark brown or buff frequently lighter on the sides and below; wings as in *rubicundulum*, and only slightly chlorinate at the very base; legs dark brown to buff; tarsi brown, black at tips; claws brown, black at tips, the ventral teeth about half as long as portion of claw beyond the tooth.

Abdomen: brown or reddish (bright red in some), terga with transverse median carina only on segments 2 and 3, the margins above the lateral carinae somewhat darker; genital hamule of the second abdominal segment composed of two equal lobes, the median pointed and black tipped, the lateral lobe rounded; auricles as long or longer than the hamules (Fig. 67, No. 5); superior anal appendages, without large ventral tooth at middle, but with a few smaller teeth, at about four-fifths the length of the appendage from the base.

Female.—Similar to male in nearly all points; sternum of segment 8 projecting ventrad for a distance about equal to one-fourth of the vertical diameter of that segment, and forming a part of the ovipositor.

Measurements: total length, male 32, female 31 mm.; length of abdomen, male 21, female 21 mm.; length of hind wing, male 23, female 22-23 mm.; width of hind wing, male 8, female 7 mm.

Differs from *rubicundulum* in being generally lighter in color;

the female venter projecting below on segment 8; the males are easily separated by means of the appendages.

Connecticut.—New Haven, 12 August, 1902 (B. H. W.), 16, 21 October, 1903 (H. L. V.), 26 July, 1906 (P. L. B.), 21 July, 1920 (P. G.); Stonington, 25 July, 1906 (J. A. H.); Storrs, 5 October, 1923 (J. Cronin). Common throughout the State.

New England.—June 24–November 8.

Genus *Pachydiplax* Brauer

Nymphs.—Labium with 10 lateral setae on palpi, and about 12 on mentum; abdomen without dorsal hooks, the lateral spines on segments 8 and 9 long (that on 9 extending beyond segment 10), and similar in size and shape; superior anal appendages not decurved.

Adults.—Wings with less than ten antenodal cross-veins; stigma with parallel proximal and distal margins, three times as long as broad, supported by 0-1 cross-veins; triangle three-sided, considerably further distad in the front wing than in the hind; M_2 not sinuate; subtriangle absent; Cu_1 not arising exactly from the caudal angle of the triangle in the hind wings, but from the distal side; caudal margin of the pronotum bilobed, and with long hairs; all femora with two ventral rows of short spines; male abdomen without ventral hooks on the first segment; transverse median carinae on abdominal terga 2 and 3; general color green, black and yellow.

Similar in habits to the Libellulas.

Pachydiplax longipennis (Burmeister)

Handbuch der Entomologie, 2: 850: 1839.

Nymph.—Color brown or greenish, shape similar to *Symptetrum*.

Head: labium with very shallow teeth, dorsum of the head smooth; 10 setae on the palpi and about 12 on each side of the mentum.

Thorax: legs slender, the femora usually with three dark rings.

Abdomen: entirely without dorsal spines, but with large lateral spines on segments 8 and 9, the spine on 9 extending well beyond the caudal margins of segment 10.

Measurements: total length, 16-19 mm.; length of abdomen, 9 mm.; greatest width of abdomen, 7 mm.; length of hind femora, 4 mm.

These measurements were made from exuviae in the Museum of Comparative Zoology. Needham's measurements (Bull 47, N. Y. State Museum, page 527) are somewhat larger, the total length being 21 mm., and the length of the femora, 6 mm.

Adult, male.—Color dark brown or green to black with greenish yellow stripes on thorax and abdomen.

Head: labium, labrum, clypeus, and most of the front white; area surrounding ocelli, and a somewhat semicircular area in front of ocelli and short lines extending ventrad along the margins of the compound eyes, dark metallic green; occiput pale; postgenae black, shining; labrum, clypeus, front, vertex with black hairs; the hairs on occiput pale; compound eyes green in life.

Thorax: prothorax uniform black, the caudal margin bilobed; meso- and metathorax with silken pilosity, dark brown or green to black with yellow markings as follows: mesanepisternum with a short longitudinal line not reaching either margin of the sclerite; and another, sometimes interrupted line above the mesopleural suture; katepisterna black or brown, pale below; mesepimerum with a pale stripe from wing bases to a point just cephalad of the spiracles and the metepisternum with a similar stripe extending well onto the anepisternum; metepimerum almost entirely yellow except the brown dorsal and cephalic borders. Coxae and trochanters sometimes light brown, the remainder of the legs black; claws with ventral teeth shorter than half the length of the claw beyond the tooth; wings as in Pl. xiv, Fig. 1.

Abdomen: uniform black or dark brown, almost completely pollinose in older specimens, pale below, especially on the anterior segments and on sides of terga 1-3; anal appendages black; hamules large and flat when viewed from below, with a small hook on the cephalo-mesal margins.

The wings show variation in the amount of infuscation, especially in the area just beyond nodus.

Female.—Head similar to that of male; thorax in general somewhat paler in color, especially the prothorax, in which the caudal and cephalic margins are pale and there is sometimes a median spot on the notum. The abdomen differs in having longitudinal yellow stripes on each side of the dorsal carina, which are composed of dashes beginning on caudal half of segment 2 and extending to segment 7; lateral margins of terga 1-5 yellow, the pale color decreasing in width from the first to fifth; venter entirely pale; superior anal appendages black, inferior brown.

Measurements: total length, male 34-40, female 28-35 mm.; abdomen, male 21-24, female 17.5-22 mm.; length hind wing, male 27-30, female 25-29 mm.; width hind wing, male 8, female 9-10 mm.

Connecticut.—New Haven, 20 July, 1908 (B. H. W.); Guilford, 13, 27 July, 1920 (P. G.); East Haven, 4 July, 1921 (P. G.).

New England.—June 7-September 9.

Genus *Leucorrhinia* Brittinger

Nymph.—Head: labium with 10-11 palpal setae and 13 mental setae; abdomen with dorsal hooks on segments 3-8, lateral spines on segments 8-9; superior anal appendages not decurved.

Adults.—Wings with less than ten antenodals; stigma with proximal and distal margins parallel, less than three times as broad, supported usually by two cross-veins; triangle three-sided, extending nearly as far distad in the hind wing as in the front; M_2 not sinuate; subtriangle absent; Cu_1 arising from caudal angle of triangle; hind lobes of prothorax bilobed and with long hairs; all femora with only a single ventral row of heavy setae, and these sometimes wanting on the proximal portion; male abdomen without hooks on venter of segment 1; transverse carinae only on segments 2 and 3; general color black.

The nymphs inhabit submerged vegetation, and the adults are usually found near the nymphal habitat. They are not as tireless on the wing as many Libellulids and are not known to congregate in droves. They are fond of bright sunlight. Oviposition is accomplished by the usual method of dipping the abdomen in the water while in flight.

For literature dealing with adults of the genus see—

Hagen, H. Transactions of the American Entomological Society, 17: 229-245: 1890, pl. x.

Muttkowski, R. A. Bulletin of the Wisconsin Natural History Society (2), 6: III: 1908.

For systematic and descriptive treatises on the nymphs of this genus see—

Walker, E. M. Canadian Entomologist, 48: 414-422: 1916: pls. XII, XIII; *Ibid.*, 45: 168: 1913.

Key to Species

Nymphs³⁸

1. Dorsal hooks present on abdominal segments 2 to 8; venter of abdomen without longitudinal dark bands 2
 Abdominal segments 7 and 8 without dorsal hooks, venter of abdomen with 3 conspicuous longitudinal dark bands (rarely inconspicuous) 5
2. Eyes very prominent; lateral spines of segment 9 extending back nearly or quite as far as tips of inferior appendages (*frigida*)
 Eyes less prominent; lateral spines of segment 9 not extending back as far as tips of inferior appendages 3
3. Dorsal hook of segment 7 as long as mid-dorsal length of the segment, that of segment 8 projecting well over the base of segment 9; lateral spines of segment 8 more or less divergent, their outer margins not continuing the regular curve of the abdominal margin; lateral spines of segment 9 extending beyond tips of lateral appendages 4
 Dorsal hook of segment 7 shorter than the mid-dorsal length of the segment, that of segment 8 projecting barely over the base of segment 9, lateral spines of segment 8 slightly convergent, their outer margins continuing the general curve of the abdominal margin; lateral spines of segment 9 not reaching beyond tips of lateral appendages (*proxima*)
4. Spinules on inner margin of lateral lobes of labium mostly in groups of 3; lateral setae 10; dorsal hook of segment 8 not declined, directed straight caudad at apex *intacta*

³⁸ From Walker, Canadian Entomologist, 48: 415-416: 1916.

- Spinules on inner margin of lateral lobes of labium mostly single; lateral setae 11; dorsal spine of segment 8 generally somewhat declined, the tip sometimes resting on dorsum of segment 9 (glacialis)
5. Length less than 18 mm.; lateral spines of segment 8 two-fifths to one-half as long as the lateral margin of the segments (not including spine); dorsal hooks absent or vestigial ones present on some of the segments (hudsonica)
- Length more than 18 mm.; lateral spines of segment 8 one-sixth to one-fourth as long as the lateral margin of the segment; dorsal hooks absent (borealis)

Adult, Males

1. Hamules without a strong ventrally projecting curved hook at the anterior end; stigma red, or reddish brown glacialis
- Hamules with a strong ventrally projecting hook at anterior end; stigma black, or dark brown 2
2. Sides of labial palpi white proxima
- Sides of labial palpi black 3
3. Abdomen with seventh segment black frigida
- Abdomen with pale spot on seventh segment 4
4. Terga 4 and 5 black or with yellow streaks on mid-dorsum; inferior anal appendage broad at tip, the distal margin rounded. intacta
- Terga 4 and 5 with red spots on dorsum; inferior anal appendage broad at tip, the distal margin angular hudsonica

Females

1. Abdomen with a yellow dorsal spot on tergum 7 2
- Abdomen without a yellow dorsal spot on tergum 7 3
2. Plates of the vulvar lamina in contact on the meson hudsonica
- Plates of the vulvar lamina separated from one another by the width of each plate intacta
3. Labium black 4
- Labium with a pale spot on each side proxima
4. Plates of the vulvar lamina almost in contact on the meson, the median notch acute frigida
- Plates of the vulvar lamina separated by a broad quadrangular excavation glacialis

Leucorrhinia frigida Hagen

Transactions of American Entomological Society, 17: 231: 1890.

Nymph.—Labium with 10 lateral setae and 9 mental setae. Teeth of palpi shallow, each with a single long spine and a smaller one alongside; distal margin of mentum subangulate; caudal margins of head rounded, the lateral surface sparsely and evenly setose; dorsal surface smooth.

Thorax: hind femora extending to abdominal segment 7.

Abdomen: with dorsal spines on segments 3-8 inclusive; lateral spines on 8 and 9, the lateral margins setose, the spines of 9 extending to the tips of the terminal appendages; length of terminals plus segment 10, about as long as, or a little longer than segment 9 measured on ventro-meson.

Measurements; immature nymph: total length, 14 mm.; length of abdomen, 7 mm.; length of metathoracic wing-cases, 2 mm.

Described from an immature nymph received from Dr. Howe labeled "Saskatchewan."

Adult, male.—Color dark brown to black.

Head: labium entirely black in specimens examined from Massachusetts.

Thorax: black; dark spot at base of hind wings not reaching the triangle; stigma with both ends, and sometimes the caudal margin, white or pale.

Abdomen: uniform brown or black, without pale spots on terga 4-10; terga 2-4 pollinose on dorsum; inferior appendage slender at tip, slightly bent; segment 2 in the hind third and on the side, 3 to the transverse carina yellowish brown (obscured in older specimens).

Female.—Terga 4-5 with small brown dorsal spots about half the length of the segments; 6-7 with a yellow streak on basal half of the dorsal carina; vulvar lamina consisting of two triangular plates a little more than half the length of the ninth sternum; the plates almost in contact on the meson.

Measurements: total length, male 28-32, female 30 mm.; length of abdomen, male 18-21, female 20 mm.; length of hind wings, male 21-24, female 22-23 mm.; width of hind wings, male 7-7.5, female 7-7.5 mm.

Specimens from Webster Lake, Massachusetts, collected by S. W. Bromley, and from Long Island by William T. Davis have also been examined.

Connecticut.—New London, 8-22 June, 1921 (R. H. H.); Litchfield, 4 July, 1915 (L. B. W.).

New England.—June 8-August 18.

Leucorrhinia glacialis Hagen

Transactions of the American Entomological Society, 17: 234: 1890.

Adult, male.—Color black and reddish brown.

Head: labium black, clypeus and front white, except the pre-ocellar black stripe extending on each side nearly to the fronto-clypeal suture; ocellar area black; vertex, occiput and postgenae black.

Thorax: mostly reddish brown marked with obscure black on the sides; venter black; legs black; wings clear, with a small brown triangle at the base of the hind wings and a trace of the same color at the base of the front wings.

Abdomen: segments 1 and 2, and 3 reddish brown, the reddish area on 3 extending slightly beyond the transverse carina on the dorso-meson; remainder of abdomen black; anal appendages black, the superiors in lateral view, with acute tips, and about 6 small, equally spaced teeth on the ventral surface from near base two-thirds the length of each superior appendage; superior a little wider at base than at apex, the distal margin concave and somewhat angular; hamules without conspicuous anterior hook.

Female.—Plates of vulvar lamina separated by a broad quadrangular excavation.

Measurements: total length, male 35, female 34 mm.; length of abdomen, male 23, female 23 mm.; length of hind wings, male 26-27, female 26 mm.; width of hind wings, male 8.5, female 8 mm.

A male in collection of Connecticut Agricultural Experiment Station without label, and one in Yale University collection from Norway, Maine, collected by S. I. Smith.

New England.—May 19-August 14.

***Leucorrhinia hudsonica* (Selys)**

Revue des Odonates ou Libellules d'Europe, 53: 1850.

Adult, male.—Color black or brown and yellow.

Head: face including labrum, clypeus and front (except a dark preocellar line) pure white; vertex black, dark brown in front; occiput and postgenae black or dark brown; labium dark, with a pale spot on each side.

Thorax: very dark brown with obscure black marks; legs black; hind wings with the dark spot not reaching distad to the triangle.

Abdomen: dorsum of terga 4, 5, 6 and 7 with pale triangles (red to yellow); occasionally a small spot on 8; sides of 2 and two-thirds of 3 yellow; anal appendages with about 5 small teeth on ventral surface of the superiors.

Female.—Vulvar lamina long, in contact on the mesal margins for more than half their length, their tips extending almost to the small knobs on the ventral surface of segment 9 nearly one-third the length of the ninth sternum.

Measurements: total length, male 32, female 27 mm.; length of abdomen, male 20, female 18 mm.; length of hind wings, male 21-23, female 22 mm.; width of hind wings, male 7.5, female 7.5 mm.

Specimens examined in the collection of Dr. P. P. Calvert.

***Leucorrhinia intacta* Hagen**

Synopsis of the Neuroptera of North America, 179: 1861.

Nymph.—Head: labium (Pl. VII, Fig. 6; Fig. 7, No. 8) with 10 lateral setae on the palpi and a minute one at base; 14 mental setae; antennae 7-segmented, the sixth segment longest.

Thorax: femora each with two faint rings of brown, the hind femora reaching abdominal segment 6 in exuviae; hind wings extending to segment 5.

Abdomen: prominent dorsal hooks on segments 2 to 8 inclusive; lateral spines on segments 8 and 9; the dorsal hook on

segment 8 extending to middle of segment 9; lateral spine on 9 reaching beyond the tips of the lateral, but not to the tips of the superior or ventral appendages. The ventral surface of the abdomen is usually transversely striated with dark stripes, or provided with rows of spots, differing in this from *Sympetrum* or other species of similar form.

Measurements: total length, 16 mm.; length of hind femora, 4-4.5 mm.; length of hind wing-cases, 5 mm.; length of abdomen, 10 mm.; greatest width, 6 mm.

Adult, male.—Color black or brown and yellow.

Head: labium dark brown to black, black on sides; labrum, clypeus and front (except the dark line in front of the ocelli, which is black) pure white; vertex shining black, dark brown in front, occiput and postgenae black or dark brown.

Thorax: very dark brown without conspicuous pale markings of any sort, prothorax black, the meso- and metathorax very dark brown with obscure black along the sutures, wing bases and on the shoulder of the mesepimerum; legs entirely black or very dark brown, the coxae, however, somewhat lighter; procoxae winged beneath, the ridge thickly beset with hair-like setae; all femora with one dorsal and one ventral carina, the latter with very short spines except near the apex, where they are longer; claws with a short ventral tooth, the length of which is less than one-half the length of claw beyond tooth; wings clear, except very small spots on base of front wings (sometimes chlorinated to nodus), and others occupying 4-6 cells (Pl. xv, Fig. 4) at the base of the hind wings.

Abdomen: variable, sometimes almost entirely black; with a yellow spot on the sides of segment 2 and another on the dorsum of 7 at base sometimes on 3 to 6; venter black; appendages black; accessory genitalia, with hamules consisting of mesal hooks, or front lobes, the caudal lobes curving completely around and coming in contact above the first lobes on the meson.

Female.—Color similar to male except that there are short lateral and dorsal dashes of yellow on abdominal terga 3, 4 and 5. The female genitalia consist of small tubercles arising from the striated ventral plate of segment 9, and two widely separated lobes arising from the caudal margin of 8; anal appendages black.

Measurements: total length, male 30-33, female 29-33 mm.; length abdomen, male 21, female 19-22 mm.; length hind wings, male 25, female 23-25 mm.; width hind wings, male 8, female 8 mm.

A rather common species taken in several different localities.

Connecticut.—Hamden, 17 June, 1904 (H. L. V.); New Haven, 4 July, 1905 (H. L. V.); Mount Carmel, 6 June, 1908 (B. H. W.); Lyme, 16 June, 1918 (B. H. W.); New London, 6-22 June, 1921 (R. H. H.), 27, 30 May, 1922 (P. G.). Also collected at Litchfield (L. B. W.), various dates.

New England.—May 17-August 3.

Leucorrhinia proxima Calvert

Transactions of the American Entomological Society, 17: 38: 1890.

Adult, male.—Color black and dark brown.

Head: face, including labrum, clypeus and front, white; labium black with pale spots on sides; vertex black.

Thorax: dark brown with obscure black on shoulders of the mesepimera and dorsal border of the metepimera.

Abdomen: segments 4-10 and anal appendages black; sides of terga 1 and 2, caudal half of the dorsum of 2, and proximal half or two-thirds of 3, brown becoming pollinose.

Female.—Labrum black, with yellow spots on sides; thorax with a broad, dark dorsal band, and obscure irregular black marks on the sides; abdomen with pale mesal spots on base of terga 4-7 inclusive; vulvar lamina short (about one-seventh as long as 9), the tips remote from the small ventral knobs on segment 9.

Measurements: total length, male 36, female 33 mm.; length of abdomen, male 24-25, female 22 mm.; length of hind wings, male 26-27, female 24-25 mm.; width of hind wings, male 8.5, female 7 mm.

Specimens in collection of P. P. Calvert examined. One specimen in Yale University collection from Norway, Maine, collected by S. I. Smith.

New England.—June 2-July 24.

Genus Celithemis Hagen

Nymphs.—Head: lateral setae 7-10; abdomen with dorsal hooks on segments 4-7; segments 8 and 9 with long straight lateral spines; superior anal appendages not decurved.

Adults.—Wings with less than ten antenodal cross-veins; proximal and distal ends of stigma parallel, the latter supported by 2-3 cross-veins; triangle 3-sided, considerably farther distad in the front wings; vein M_2 not sinuate, subtriangle absent; Cu_1 arising exactly from the caudal angle of the triangle in both wings; hind margin of the prothorax bilobed and with a fringe of long hairs; male abdomen without a hook on ventral surface of 1; transverse carinae on abdominal segment 3, and frequently a transverse median groove on 2 and 4. The wings are nearly always spotted with dark brown and are more or less flavescent.

Habits of the genus are very similar to other Libellulids. The adult, however, is not so swift on the wing as the more common Libellulas and is much more easily captured.

For literature on this genus see—

Williamson, E. B. Occasional Papers of the Museum of Zoology, University of Michigan No. 108, 1922.

*Key to Species***Nymphs³⁹**

1. Dorsal hooks well developed on abdominal segments 4 to 7, longest on segment 6 and sharp; lateral spines of the ninth segment reaching the apices of the inferior appendages; lateral setae of the labium 8 to 10**eponina**
- Dorsal hooks weakly developed on segments 5 to 7, short, but pointed lateral spines of the ninth segment not extending beyond the tip of the superior terminal appendage; lateral setae 7**elisa**

Adults**Males and Females**

1. Dark spots only on the bases of the hind wings; 1 row of cells between R_s and R_s supplement except at margin of wing ..**martha**
Dark spots beyond the base of the hind wings and also on the front wings; 2 rows of cells between R_s and R supplement ... 2
2. Both wings with a cross-band proximad of the stigma which entirely crosses the wings;⁴⁰ wings entirely suffused with yellow Pl. XIII, Fig. 1**eponina**
Wings without a cross-band proximad of the stigma, at most a spot between stigma and nodus which does not cross the wing; wings usually clear between the dark spots 3
3. Area between subcosta and R , proximad of the nodus, dark; dark spot between nodus and stigma usually bilobed, sometimes divided into two spots**monomelaena**
Area between subcosta and R , proximad of the nodus, clear; dark spot between nodus and stigma entire, never divided into two spots, Pl. XXII, b**elisa**

***Celithemis elisa* (Hagen)**

Synopsis of the Neuroptera of North America, 182: 1861.

Adult, male (Pl. XXII, b).—Head: labium black on middle, lateral lobes brown; labrum, clypeus and front, except the usual black line in front of the ocelli, reddish; vertex dark brown, black in front; occiput and postgenae next to the compound eyes, yellowish red.

Thorax: prothorax uniform black; dorsal carina much depressed; meso- and metathorax brown, with a black velvety stripe on the carina and on mesanepisternum on contact with the suture, a blotch caudo-dorsad of the spiracle and another near the wing base, on the metapleural suture; venter brown; wings not wholly flavescent, conspicuously spotted, the front wings each with a spot about 1.5 mm. across, cephalad of the triangle, another twice as large between nodus⁴¹ and stigma, and a still larger one at tip of, but not quite covering the apex; base of the wing yellow and cubito-anal, antenodal, and postnodal cross-veins infuscated; hind

³⁹ Needham, Aquatic Insects in the Adirondacks. Bull. N. Y. State Museum, 47: 514: 1901.

⁴⁰ Sometimes interrupted, forming two spots.

⁴¹ Specimens in the collection of Dr. R. H. Howe, Jr., lack the dark spot between nodus and stigma entirely.

wings with a large semiopaque spot covering the base and anal angles, the spot enclosing a clear yellow area; there is also a spot between nodus and stigma and one across band just beyond stigma; antenodal and postnodal cross-veins are infuscated; stigma reddish; legs mostly black, the coxae, trochanters, and venter of the front femora brown; claws with ventral tooth, less than one-half the length of the claw beyond.

Abdomen: black and yellow or more frequently red; terga 1 and 2 black above, red on sides; 3 entirely red, with small, black dorsal, somewhat shield-shaped spot, the caudal margin also black on each side of the meson; dorsum of 4 red, with black dorsal spot on cephalic margin and two spots contiguous with the caudal margin; tergum 5 with caudo-lateral angles of dorsum black, remainder red; 6 and 7 with a dorsal triangle of red, the remainder black; terga 8, 9 and 10 black; superior anal appendages brown, inferior black.

Female.—Similar to the male, but the reddish color everywhere replaced by yellow; wings with dark spot at tips considerably reduced, forming a crossband in the hind wings; abdomen with yellow dorsal triangles on terga 3-7, the sides of 1-4 yellow, a smaller dorsal spot on dorsum of two; venter of terga 1-8 pale, becoming black; superior anal appendages yellow above, black below and at tips.

Measurements: total length, male 31-34, female 30 mm.; length of abdomen, male 18-22, female 19-20 mm.; length of hind wing, male 27-28, female 27 mm.; width of hind wing, male 10, female 10 mm.

A daintily marked species of frequent occurrence in Connecticut.

Connecticut.—New Haven, 27 June, 1905 (W. E. B.); Yalesville, 4 July, 1907 (B. H. W.); Hamden, 18 July, 1920; Easton, 6 July, 1922 (P. G.); Greenwich, 30 June, 1924 (J. L. R.); Putnam (Pierce).

New England.—May 19-August 23.

***Celithemis monomelaena* Williamson**

Ohio Naturalist, 10: 155: 1910.

Nymph.—Unknown.

Adult, male.—Color black.

Head: labium pale; front bluish metallic.

Thorax: obscurely brown, the wings clear, not flavescent, and marked with a black band extending to the nodus and a spot behind this; a spot between nodus and stigma usually divided, but sometimes fused; and the tips of the wings also dark.

Abdomen: black.

Female.—Marked with yellow; most of the face pale, a spot on the vertex and a pale stripe on the thorax also pale; small pale triangular spots on abdominal segments 2 to 7 and lateral stripes on segments 3 to 5 inclusive, the triangles of the dorsum, however, not as long as the segments.

Measurements: total length, male 34, female 30 mm.; length of abdomen, male 21, female 19 mm.; length of hind wings, male 26, female 25 mm.; width of hind wings, male 10, female 9 mm.

New England.—July 8-August 20.

Celithemis eponina (Drury)

Illustrations of Natural History—Exotic Insects, 2: pl. XLVII, f. 2: 1773.

Nymph.—Head: labium with 9 to 10 lateral setae on the labial palpi, the crenulations of the mesal margins with 4 to 5 spines each; antennae with segments 3, 5, and 6 equal in length, 4 and 7 equal, 1 and 2 equal, shorter.

Thorax: hind femora extending to abdominal segment 8; wing-cases extending to segment 6.

Abdomen: color pattern somewhat similar to *Tetragoneuria* (see Pl. IV, Fig. 4), lateral spines of segment 9 reaching the ends of the terminal appendages; dorsal spines present on segments 4 to 7.

Measurements: total length, 16 mm.; length of abdomen, 9 mm.; width of abdomen, 5 mm.; length of hind femora, 5 mm.

Specimens in the Museum of Comparative Zoology examined.

Needham (Bull. 47, N. Y. State Museum, p. 515) gives the length of this species as 21 mm., abdomen, 12.5 mm., hind femur, 6 mm.

Adult, male.—Color, body black and brown, wings brown and yellow.

Head: labium, labrum, clypeus and front brown or yellow, the region immediately in front of the ocelli darker; vertex and occiput dark brown, the postgenae, however, with a few small spots near the lateral margins of the compound eyes.

Thorax: uniform brown with obscure dark markings on mid-dorsum, and two on pleura. Legs black and dark brown, coxae, trochanters, and ventral surface of the femora brown, remainder black; front coxae winged below, the ridge with a fringe of setae; wings wholly flavescent, with dark brown spots (Pl. XIII, Fig. 1).

Abdomen: black with an elongated mid-dorsal spot on terga 2 or 3-7, and sides of 1-4 or 5 yellow; remainder of terga and venter black, superior anal appendages brown, inferior black; transverse median ridge on tergum 3, and a transverse groove on 2 and 4.

Female.—In general, lighter in color, and the nodal brown band of the wings more often interrupted and forming two separate spots; vulvar lamina short, broad, one-seventh to one-tenth as long as segment 9.

Measurements: total length, male 36-39, female 36 mm.; length of abdomen, male 23-24, female 23 mm.; length of hind wings, male 32, female 30 mm.; width of hind wings, male 11-12, female 11-12 mm.

Connecticut.—South Manchester, 3 August, 1896 (W. C. S.); Whitneyville, 19 August, 1904 (P. L. B.); New Haven, 18 July, 1908 (B. H. W.); North Haven, 10 August, 1921 (P. G.); Hamden, 6 July, 1922 (J. L. R.).
New England.—June 21–September 3.

Celithemis martha Williamson⁴²

Occasional Papers of the Museum of Zoology, University of Michigan, 108: 4-6: 1922; Pl. I, Figs. 1, 2; Pl. II, Figs. 7, 8.

Nymph.—Unknown.

Adult, male.—Color black, or black and yellow.

Head: face almost entirely brown; labrum brown; occiput and postgenae black.

Thorax and legs black with a bluish tint; wings clear except a large black or brownish spot 4 to 5 mm. in diameter; the front wings, however, sometimes yellow at base, dark spot of the hind wings divided more or less completely by a clear yellow band, two rows of cells present between M_4 and Cu_1 at the level of the nodus in the front wing; no nodal or apical spots.

Abdomen: black, yellow as follows: dorsal spot on tergum 2 at apex, and also sides of same; all of tergum 3 except lateral margins and a lateral black stripe widened caudad; spot on dorsum of 4, widened nearly to the margins; elongate triangular spots on 5, 6, and 7; segments 8, 9 and 10 black.

Female.—Pale yellow triangles on abdominal segments 5, 6 and 7; segments 1 and 2 entirely pale, 3 and 4 largely so except an apical ring on 3 and apical ring and lateral triangle on 4; spots on the bases of the hind wings well divided by the yellow band; first three or four antenodal cross-veins (sometimes only two) in front and hind wings infuscated.

Measurements: total length, male 32-33, female 25-29 mm.; length of abdomen, male 19-20, female 16-18 mm.; length of hind wings, male 26, female 23-24 mm.; width of hind wings, male 9, female 8.5 mm.

Specimens determined by Williamson in the Museum of Comparative Zoology have been examined; also specimens collected at Whites Bog, N. J., by the writer.

New England.—July 2–August 21.

Tribe TRAMEINI Tillyard

Nymphs of the Trameini have long lateral spines on the abdominal segments 8 and 9, and the labium is very large and of characteristic form (see Pl. IV, Fig. 2); the adults possess broad wings measuring 15 mm. or usually more at base, and the distal and proximal margins of the stigma are not parallel.

⁴² *Celithemis ornata* of many authors.

*Key to Genera***Nymphs**

1. Movable hook of the labial palpi long and slender, setiform; lateral spines of the eighth abdominal segment longer than those on segment 9 and extending beyond the caudal margin of that segment (Pl. iv, Fig. 2) **Tramea, p. 289**
- Movable hook of the lateral arms hardly longer than the teeth, especially the two next the movable hook; spines of the eighth abdominal segment not usually extending beyond the caudal margin of that segment **Pantala, p. 292**

Adults

1. Abdomen without transverse median carina on segment 5; not more than two transverse carinae on segment 3; veins M_2 and R_s not conspicuously sinuate at middle (Pl. xv, Fig. 2) **Tramea, p. 289**
- Abdomen with transverse median carina on segment 5; also three prominent transverse carinae on segment 3; veins M_2 and R conspicuously sinuate at middle (Pl. xv, Fig. 1) ... **Pantala, p. 292**

Genus Tramea Hagen

Nymphs.—Head with 10-11 setae on the palpi; 14-15 mental; abdomen without dorsal hooks, the lateral spine on segment 8 longer than on 9; anal appendages not decurved, the superior suddenly contracted beyond the basal third.

Adults.—Ten or more antenodal cross-veins in the front wing; proximal and distal margins of the stigma not parallel, the stigma about three times as long as broad and supported by 1 to 2 cross-veins; M_2 not sinuate; triangle 3-sided, considerably farther distad in the front wing; subtriangle absent; Cu_1 arising exactly from the caudal angle of the triangle in the hind wings; caudal margin of the pronotum entire; male abdomen without hooks on the venter of the first abdominal segment; transverse median carinae on abdominal terga 2, 3 and 4; general color dark brown to black.

The adults of this genus that I have seen on the wing were skimming over the surfaces of small ponds or lakes and were exceedingly difficult to capture. No nymphs from Connecticut have been seen but there is little doubt that they occur in the waters about which adults have been seen. They live in submerged vegetation.

Byers, C. F. (Jour. N. Y. Ent. Soc. 35: 73: 1927) has published a key to nymphs.

*Key to Species***Nymphs**

1. Fourth segment of the antennae three-fourths as long as the third **carolina**
- Fourth segment of the antennae one-half as long as the third. **lacerata**

Adults

Males and Females

1. Dark area at the base of the hind wings about 4 mm. wide, not extending to the costa or as far distad as the triangle. **abdominalis**
Dark area at the base of the hind wings more than 4 mm. wide and extending to the costa and distad to the triangle 2
2. Superior appendages of the male as long as segment 9 plus 10; female with vulvar lamina not quite as long as 9, its apical three-fourths divided, forming 2 lobes with apices entire **carolina**
Superior appendages of the male as long as the last three (8, 9 and 10) segments together; vulvar lamina of the female half as long as segment 9, bilobed, the apices of the lobes emarginate **lacerata**

Tramea abdominalis (Rambur)

Histoire naturelle des insectes. Neuroptères, 37: 1842.

Adult, male.—Color dark brown.

Head and thorax: uniform brown, legs darker distad; wings with brown spot only on the anal angles of the hind wings and not including a pale streak on the mesal margin (Pl. xv, Fig. 2).

Abdomen: brown with black dorsal triangles on segments 8, 9 and 10; superior anal appendages 4 mm. long, the inferior slightly less than half this.

Female.—Vulvar lamina as long as segment 9, each plate broad and rounded at tip.

Measurements: total length, male 47, female 46 mm.; length of abdomen, male 26-28, female 27 mm.; length of hind wings, male 40, female 40 mm.; width of hind wings, male and female, 14-15 mm.

New England.—August.

Tramea carolina Linnaeus

Amoenitates Academicae, 6: 411: 1763.

Adult, male.—Color dark brown and black.

Head: labium with black or brown mentum, and reddish brown palpi; labrum and clypeus brown, front mostly brown or black; vertex broad, apex not concave; occiput and postgenae brown.

Thorax: uniform brown, caudal margin of the pronotum entire and with few or no hairs; legs black, the coxae, trochanters, and part of the femora brown; tarsal claws, with teeth much beyond the middle; hind wings with a large brown area at base, covering the entire width of the wing for about half the distance between base and nodus, and enclosing a small clear spot on the anal angle; median or basilar space also clear in some; front wings with a touch of brown at the extreme base; anal angle of the hind wings much enlarged and with numerous small narrow cells.

Abdomen: brownish red, terga 8, 9 and sometimes 10 black above; anal appendages brown, as long as terga 9 plus 10, the

superiors about twice as long as the inferior; hamules (Fig. 63, No. 14) without lateral lobes, and consisting entirely of hooks which are longer than the auricles (genital lobes).

Female.—Brown area of the hind wings enclosing a somewhat larger pale spot on the mesal margin; vulvar lamina about as long as segment 9 and bifid for about two-thirds its length.

Measurements: total length, male 52, female 45-49 mm.; length of abdomen, male 27-30, female 27-30 mm.; length of hind wings, male 41-43, female 43 mm.; width of hind wings, male 17-18, female 16-18 mm.; length of stigma, male and female, 2 mm.; superior anal appendage, male 3.5 mm.

Distinguished from most other Libellulids by the great width of the hind wings and the shape of the stigma; from *T. lacerata*, by the shorter anal appendage of the male, and the longer hamules, as well as by the smaller enclosed pale triangle on the proximo-anal margin of the wings in both sexes.

Connecticut.—Branford, 26 May, 1918 (B. H. W.).

New England.—May 26-September 8.

Tramea lacerata Hagen

Synopsis of the Neuroptera of North America, 145: 1861.

Nymph (Pl. iv, Fig. 2).—Color brown.

Head: labium very large, the mentum extending between the middle pair of coxae, the front margin projecting considerably, evenly rounded and with but few spines or setae; palpi very broad, the mesal margins with about 10 rounded teeth with small denticles and 3-4 larger spines on each tooth; mental setae 14-15 (Needham); antennae 7-segmented, the fourth segment half as long as the third; dorso-mesal margins of the compound eyes with an angle, the angles of the two separated by 1.5 mm.

Thorax: pronotum forming a plate which extends back over the mesothorax nearly to the base of the wing-pads and hides the mesothoracic spiracles completely; legs yellow, with indefinite brown rings on the femora, the hind femora about 8 mm. long; outer wing-pads very broad at base (4.1 mm.), extending to the eighth abdominal segment.

Abdomen: broad, the lateral margins thin and plate-like, the lateral keels of 8 and 9 with very long spines (Pl. iv, Fig. 2), the distance from the tip of the spine to base of the segments bearing them being 4.5-5 mm.; anal appendages nearly equal in length, the laterals a trifle shorter than the median, and this in turn a little shorter than the ventral.

Measurements: total length, 24 mm.; length of hind femora, 8 mm.; length of mentum, 6.5 mm.; width, 5 mm. to 2 mm. at base; length of metathoracic wing-cases, 6 mm.; greatest width of abdomen, 9 mm.

Described from a nearly full-grown nymph obtained from Dr. Calvert, collected at "Phila. Neck, Pa."

Adult, male.—Color black and brown or yellow.

Head: uniform dark brown, labium pale; front above with a purple reflection.

Thorax: dark brown with bluish reflection; dark pigment at base of the front wing extending to the first antenodal cross-vein; hind wings with black extending half way to the nodus, the anal margins with a pale spot on each, next the abdomen.

Abdomen: anal appendages long (5 mm.) bent just before the middle, the inferior not quite half the length of the superiors.

Female.—Vulvar lamina with mesal margins sinuate (dried specimens), the median notch between the two plates extending to the base of the segment.

Measurements: total length, male 51, female 50 mm.; length of abdomen, male 30, female 32 mm.; length of hind wings, male 42-43, female 45 mm.; width of hind wings, male 17, female 18 mm.

Easily distinguished from *carolina*, its closest relative, by the dark spot at the base of the fore wings.

Connecticut.—Wallingford, 6 June, 1923 (P. G.).

New England.—June 6-September 10.

Genus *Pantala* Hagen

Nymphs.—Head with 12 to 14 lateral setae on the palpi; 15 mental; abdomen without dorsal hooks; lateral spine on segment 8 reaching the caudal margin of segment 9.

Adults.—More than 10 antenodal cross-veins in the front wings; proximal and distal margins of the stigma not parallel; M_2 strongly sinuate; triangle three-sided much further distad in the front wing; subtriangle present; Cu_1 arising exactly from the caudal angle of the triangle in the hind wings. Caudal margin of the pronotum entire; male abdomen without hooks on the venter of the first abdominal segment; transverse carinae on terga 2, 3, 4 and 5; general color brown and green.

It is doubtful if more than an occasional representative of this genus will ever be found in Connecticut, and so far as known there is no evidence that either species listed breeds in the State.

Key to Species

Nymphs

1. Movable hook or distal segment of the palpi twice as long as the crenulations of the distal edge of the proximal segment ... *hymenea*
 Movable hook or distal segment of the palpi less than twice as long as the crenulations of the proximal segment *flavescens*

Adults

Males and Females

1. Both sexes with a conspicuous brown spot in the anal angle of the hind wings; stigma of the front wings more than 3 mm. long **hymenea**
 No conspicuous brown spot in the anal angle of the hind wings, the color diffused over the width of the wing; stigma of the front wings 2.5 mm. long **flavescens**

***Pantala flavescens* (Fabricius)**

Supplementum Entomologiae Systematicae, 285: 1798.

Nymph.—Head large as in *Tramea*, antennae weak, 2.5 mm. long, and composed of 6 segments; teeth of the mesal margin of the palpi fully as long as high, movable spine heavy, not setiform, scarcely longer than the teeth.

Thorax: femora slender, ridged, not compressed; tips of hind femora extending to abdominal segment 5, the wing-cases also to segment 5.

Abdomen: smooth, with long lateral spines on segments 8 and 9, those on 8 about as long as segment 9; terminal appendages long and slender, the laterals about three-fourths as long as the ventrals; ventral surface of abdomen not greatly depressed along the two longitudinal lines in the specimens examined.

Measurements: total length, 24-26 mm.; length of abdomen, 15 mm.; length of hind femora, 7 mm.; wing-cases, 6 mm.; width of abdomen, 8 mm.

Specimens examined in the Museum of Comparative Zoology.

Adult, male.—Color green or brown and yellow.

Head: face including labrum, clypeus and front yellow, often with a reddish spot at middle; vertex yellow; rear of head brown and yellow.

Thorax: green to yellow with white pilosity, brown above; pronotum entire; coxae pale; femora pale above, tibiae sometimes lined with yellow; wings clear (Pl. xv, Fig. 1), the anal angle chlorinated (clear yellow); stigma yellow or brown; tips of wings sometimes with a brown spot.

Abdomen: greenish or yellowish, conspicuous for its transverse carinae; tergum 2 with two carina; 3 and 4 with three; 5 with one at middle and another at caudal margin; dorsum of terga 4-8 inclusive with a faint brown spot, having lateral arms behind the middle of each spot; tergum 9 with a subcircular spot; dorsum of 10 black; sides of terga 2, 3 and 4, with short, bent, sometimes interrupted dashes, 5-8 with dark dashes or spots below the lateral carinae; anal appendages with superiors yellow at bases, darker at tips, with a weak, obtuse ventral angle a little beyond the middle; and with a row of small teeth proximad of the angle.

Female.—Color similar to the male; the shoulders of mes- and

metepimera black in some; ventral projection of segment 9 keeled below, bluntly rounded at tip.

Measurements: total length, male 50, female 47 mm.; length of abdomen, male 27-33, female 30-34 mm.; length of hind wings, male 36-42, female 40 mm.; width of hind wings, male 13-15, female 15 mm.; length of stigma, 2-2.5 mm.

This species is typically Southern but occasionally strays north into New England.

Pantala hymenea (Say)

Journal of the Academy of Natural Sciences of Philadelphia, 8: 19: 1836.

Nymph.—Head: mental setae 15 to 16; setae on the proximal segment of the palpi 15; antennae with second segment longest; rear of the head with three small dark spots near the mid-dorsal line.

Thorax: femora each with two dark rings, the wing-cases mottled and reaching the middle of the sixth abdominal segment.

Abdomen: a pair of conspicuous U-shaped spots on the dorsum of segment 9; minute needle-like dorsal hooks on segments 3 and 4; terminal appendages slightly longer than the combined length of segments 8 to 10.

Measurements: total length, 28 mm.; length of abdomen, 18 mm.; length of hind femora, 7 mm.

Description from Kennedy, Canadian Entomologist, 55: 36-38: 1922.

Adult, male.—Color olive-green and brown.

Head: face orange-red except the labium, labrum, ante-clypeus, and a small area just in front of the ocelli, which are yellow; prominence between the ocelli also yellow.

Thorax: front and middle femora almost entirely brown, the tibiae of the same lined with yellow above; tarsi of all legs black; wings with a yellowish brown spot in the anal angle of the hind wings about 5 to 6 mm. in diameter; tips of wings faintly clouded.

Abdomen: brown with darker triangles on the dorsum of segments 8 and 9; mid-dorsal carina on segments 2 to 6; one transverse carina on tergum 2, three on tergum 3 and 4, two on 5, and one each near the caudal margins of terga 6 to 9 inclusive; superior anal appendages brown, the inferior about two-thirds as long as the superiors.

Female.—Similar to the male but lacking the orange color on the face; brown spot of the hind wings slightly smaller than that of the male.

Measurements: total length, male 50, female 50 mm.; length of abdomen, male 29-32, female 30-32 mm.; length of hind wings, male 40-42, female 43-44 mm.; width of the hind wings, male and female, 16 mm.

An American species of wide distribution recorded from Pennsylvania and New Jersey.

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SPECIES OF ODONATA TREATED IN THIS PAPER

Zygoptera

<i>Lestes congener</i> Hagen*	<i>Teleallagma daeckii</i> (Calvert)
<i>disjunctus</i> Selys*	<i>Enallagma aspersum</i> (Hagen)*
<i>eurinus</i> Say*	<i>calverti</i> (Morse)*
<i>forcipatus</i> Rambur*	<i>carunculatum</i> Morse*
<i>inaequalis</i> Walsh*	<i>civile</i> (Hagen)*
<i>rectangularis</i> Say*	<i>cyathigerum</i>
<i>uncatus</i> Kirby*	(Charpentier)*
<i>unguiculatus</i> Hagen*	<i>divagans</i> Selys*
<i>vigilax</i> Hagen*	<i>durum</i> Hagen*
<i>Argia moesta</i> (Hagen)*	<i>doubledayi</i> Selys
<i>translata</i> Hagen*	<i>ebrium</i> (Hagen)*
<i>violacea</i> Hagen*	<i>exsulans</i> (Hagen)*
	<i>geminatum</i> Kellicott*

* Collected in or reported from Connecticut.

Enallagma hageni (Walsh)*	Chromagrion conditum Hagen*
laterale Morse*	Ischnura kellicotti Williamson
recurvatum Davis	posita (Hagen)*
signatum (Hagen)*	ramburii Selys*
traviatum (Hagen)*	verticalis Say*
minusculum Morse	Anomalagrion hastatum Say*
pictum Morse	Agrion aequabile (dimidiatum)
vesperum Calvert*	(Say)*
Nehallenia irene Hagen*	amatum (Hagen)*
gracilis Morse	apicale (Burmeister)
integricollis Calvert	maculatum Beauvois*
Amphiagrion saucium (Burmeister)*	Hetaerina americana (Fabricius)*

Anisoptera

Tachopteryx thoreyi (Hagen)	Boyeria vinosa (Say)*
Cordulegaster diastatops (Selys)*	Basiaeschna janata (Say)*
erroneus Hagen*	Gomphaeschna furcillata (Say)*
maculatus Selys*	Anax junius (Drury)*
obliquus (Say)*	longipes Hagen
Progomphus obscurus (Rambur)	Aeshna canadensis Walker*
Hagenius brevistylus Selys*	clepsydra Say*
Ophiogomphus anomalus Harvey	constricta Say*
aspersus Morse*	eremita Scudder
colubrinus Selys	tuberculifera (Walker)*
howei Bromley	umbrosa Walker*
mainensis Packard*	verticalis Hagen*
rupinsulensis	Epiaeschna heros (Fabricius)*
(Walsh)*	Nasiaeschna pentacantha (Rambur)*
Lanthus parvulus (Selys)*	Didymops transversa (Say)*
albastylus (Hagen)*	Macromia illinoiensis Walsh
Gomphus abbreviatus Hagen*	taeniolata Rambur
adelphus Selys	Epicordulia princeps (Hagen)*
amnicola Walsh	Neurocordulia obsoleta (Say)
borealis Hagen*	yamaskanensis
brevis Hagen*	(Provancher)*
crassus Hagen	Helocordulia uhleri (Selys)*
descriptus Banks	Tetragoneuria canis (MacLachlan)
exilis Selys*	(semiaquaea)
externus Hagen	cynosura (Say)*
fraternus (Say)	spinigera Selys*
furcifer Hagen*	Dorocordulia lepida (Hagen)*
graslinellus Walsh	libera (Selys)*
lineatifrons Calvert	Williamsonia lintneri (Hagen)
lividus Selys*	Cordulia shurtleffi Scudder*
notatus Rambur	Somatochlora albicincta
pallidus Selys	(Burmeister)
plagiatus Selys	cingulata (Selys)
quadricolor Selys	elongata var. minor
scuderi Selys*	Calvert*
spicatus Hagen*	filosa (Hagen)
spiniceps (Walsh)	forcipata (Scudder)
vastus Walsh	linearis (Hagen)*
ventricosus Walsh*	tenebrosa (Say)*
villosipes Selys*	walshii (Scudder)*
Dromogomphus spinosus Selys*	williamsoni Walker*
spoliatus (Hagen)	

<i>Libellula auripennis</i> Burmeister*	<i>Sympetrum danae</i> Sulzer (scoticum)
<i>cyanea</i> Fabricius*	<i>obtrusum</i> (Hagen)*
<i>exusta</i> (Say)*	<i>rubicundulum</i> (Say)*
<i>flavida</i> Rambur, var. of	<i>semicinctum</i> (Say)*
<i>cyanea</i>	<i>vicinum</i> (Hagen)*
<i>incesta</i> Hagen*	<i>Pachydiplax longipennis</i>
<i>luctuosa</i> Burmeister*	(Burmeister)*
<i>pulchella</i> Drury*	<i>Leucorrhinia frigida</i> Hagen
<i>quadrifasciata</i> Linnaeus*	<i>glacialis</i> Hagen*
<i>semifasciata</i> Burmeister*	<i>hudsonica</i> (Selys)
<i>vibrans</i> Fabricius*	<i>intacta</i> Hagen*
<i>Plathemis lydia</i> (Drury)*	<i>proxima</i> Calvert*
<i>Perithemis tenera</i> (Say)*	<i>Celithemis elisa</i> Hagen*
<i>Nannothemis bella</i> (Uhler)*	<i>eponina</i> Drury*
<i>Erythrodiplosis berenice</i> (Drury)*	<i>monomelaena</i> Williamson
<i>Erythemis simplicicollis</i> (Say)*	<i>martha</i> Williamson
<i>Sympetrum ambiguum</i> (Rambur)	<i>Pantala flavescens</i> (Fabricius)
(albifrons)	<i>Tramea abdominalis</i> (Rambur)
<i>assimilatum</i> (Uhler)	<i>carolina</i> (Linnaeus)*
<i>corruptum</i> (Hagen)*	<i>lacerata</i> Hagen*
<i>costiferum</i> (Hagen)	

Statistics

Families	Genera	Species	Species recorded from Connecticut
Coenagrionidae	9	42	34
Agrionidae	2	5	4
Petaluridae	1	1	—
Cordulegasteridae	1	4	4
Gomphidae	6	36	16
Aeshnidae	7	14	12
Libellulidae	22	62	42
Total	48	164	112

List of Abbreviations of Collectors' Names Occurring Throughout the Text After Locality Records

W. E. B.—W. E. Britton.	H. L.—H. Lange.
S. W. B.—S. W. Bromley.	Q. S. L.—Q. S. Lowry.
P. L. B.—P. L. Buttrick.	E. J. S. M.—E. J. S. Moore.
K. F. C.—K. F. Chamberlain.	L. B. P.—Lawrence B. Parker.
J. C.—J. Cronin.	L. B. R.—L. B. Ripley.
I. B. D.—I. B. De.	J. L. R.—J. L. Rogers.
G. A. F.—Miss Grace A. Foote.	W. C. S.—W. C. Sturgis.
P. G.—Philip Garman.	H. L. V.—H. L. Viereck.
G. H. H.—George H. Hollister.	B. H. W.—B. H. Walden.
R. H. H.—R. Heber Howe.	H. W. W.—H. W. Winkley.
J. A. H.—J. A. Hyslop.	L. B. W.—L. B. Woodruff.
J. A. M.—J. A. Manter.	M. P. Z.—M. P. Zappe.
H. B. K.—Harry B. Kirk.	

GLOSSARY

A: Anal vein.

Accessory appendages: Genital appendages on the venter of the second abdominal segment.

Accessory genitalia: Genital appendages on the venter of the second abdominal segment.

Acuminate: Tapering to a long point.

Anal appendages: Movable appendages at the tip of the abdomen.

Anal loop: The area including a few to many cells, between the branches of the anal vein, or between cubitus and the first anal vein.

Anal membrane: A semiopaque membrane in the hind wing of some Odonata beginning at the articulation of the wing and extending along the hind margin; also called **membranule**.

Anal vein, -s: The sixth to the ninth longitudinal vein located behind the cubitus and commonly short or abbreviated in Odonata.

Anepisternum: The dorsal division of the episternum (supraepisternum); **mesanepisternum:** anepisternum of mesothorax; **metanepisternum:** anepisternum of metathorax.

Annulate: Ringed or marked with colored bands.

Annuli: Rings.

Anteclypeus: The lower of two divisions of the clypeus.

Antenna, -ae: Segmented sensory appendages borne one on each side of the head; "feelers."

Antenodal cross-veins: Cross-veins between C and R, proximad of the nodus.

Anterior lamina: Anterior plate of the accessory genitalia of male Aeshnae.

Approximate: Near or close together.

Arculus: In Odonata a cross-vein between radius and cubitus from which the median vein apparently arises.

Auricles: Ear-like protuberances on the second abdominal segment.

Basal lobes: Small plates at the base of the ovipositor.

Basilar space: A cell at the base of the wing bounded by radius, cubitus, arculus, and the base of the wing; also median space.

Bifid: Divided into two parts; split.

Bifurcate: Divided not over half its length into two parts; forked.

Bisinate: With two sinuations or curves.

Boreal: Belonging to the faunal region extending from the polar sea southward to near the northern boundary of the United States, and further south in the Rockies.

Bridge: Wing vein connecting radial sector with media.

C: Costa.

Carina: Ridge.

Carinate: Ridged.

Caudad: Towards the rear.

Cephalad: Towards the head.

Cephalo-mesal: Towards the head and at the same time towards the meson.

Cercus, -i: Lateral cylindrical appendages at the tip of the abdomen.

Chitin: Substance forming the external skeleton of insects.

Chlorinated: Transparent yellow.

Claws: Hooks at the tips of the legs; commonly tarsal claws.

Clypeus: A head sclerite below the front and above the labrum.

Compound eyes: Large eyes on the lateral surface of the head, composed of many smaller divisions.

Confluent: Running together; said of two spots that coalesce.

Contiguous: So near together as to touch.

Costa: The vein forming the front margin of the wing; first longitudinal vein.

Coxa, -ae: The segment of the leg next the body; **pro-** front; **meso-** middle; **meta-** hind coxae.

Coxal process: A point on the pleura about which the coxa rotates in its socket and which marks the ventral terminus of the pleural sutures.

Crenulate: With small scallops, evenly rounded and rather deeply curved.

Crepuscular: Active or flying at dusk.

Cu₁, Cu₂: Branches of cubitus.

Cubito-anal cross-veins: Veins connecting cubitus and first anal veins.

Cubitus: The fifth longitudinal vein; the vein just behind the media.

Cuneiform: Wedge-shaped.

Declivous: Sloping downwards.

Denticulate: Provided with small teeth.

Dimorphic: Differently colored in the two sexes.

Distad: Towards the outer end of an appendage; away from the body; opposed to proximad.

Distal: Of or belonging to portions of appendages farthest from the body.

Divaricate: Spreading apart.

Dorsad: Towards the dorsum or back.

Dorsal: Of or belonging to the upper surface.

Dorsal punctures: Punctures or spots on the dorsum.

Dorso-meson: Intersection of the meson with the dorsal surface of the body.

Dorsum: The upper surface of the body, or segment of the body.

Emarginate: Notched; with an obtuse, rounded, or quadrate section cut from margin.

Epicranial suture: A Y-shaped suture on the dorsum of the head.

Epimerum -a: The caudo-ventral plate of the pleurum in Odonata; same as **epimeron**.

Episternum -a: The anterior or cephalic divisions of the pleura.

Exuviae: Skin cast off at molting; usually applied to the final skin cast before the adult emerges. This word is always plural in form, being similar to the English word "clothes."

Face: The front of the head below the antennae.

Falciform: Sickle-shaped.

Femoral setae: Setae on the femora.

Femur, -ora: The fourth leg segment in Odonata, considering the trochanters as two-segmented.

Flavescent: Slightly smoky.

Forcipate: Bearing forceps or similar shaped structures.

Front: That portion of the head between the compound eyes, from ocelli to clypeus.

Frontal vesicle: In Aeshnidae and others, a swelling between the compound eyes, bearing the ocelli.

Fuscous: Dark brown approaching black.

Gena, -ae: The cheeks; sides of the face below the compound eyes.

Gills, tracheal: Plates at the tip of the abdomen in the nymphs of Zygoptera which contain tracheae and are used for breathing.

Glabrous: Smooth, free from all vestiture; lacking setae or spines.

Gonapophysis, -es: The leaf-like processes of the ovipositor.

Hamular process: A fork of the hamule.

Hamules: Usually forked appendages of the second segment of the male; posterior lamina.

Humeral: Relating to the shoulder.

Inferiors: The lower anal appendages.

Infraepisternum: The lower division of the episternum; katepi-sternum.

Infuscated: Smoky gray-brown; sepia.

Instar: The period or stage between molts.

Internal triangle: Triangular wing cell behind and proximad of the triangle.

Interpleural suture: Suture between meso- and metapleura.

Intersternum: A large sclerite on the sternum of the thorax just in front of the abdomen.

Invagination: A pouch or sac formed by the infolding or indrawing of the outer surface.

Katepisternum: The lower division of the episternum; the infraepi-sternum.

Labial palpus, -i: Paired, jointed appendages of the labium.

Labium: A hinged appendage folded beneath the head.

Labrum: The ventral flap attached to the clypeus on the front of the head.

Lanceolate: Lance- or spear-shaped; oblong and tapering to the end.

Laterad: Towards the side, away from the meson.

Lateral keel: Ridges on the sides of the abdomen.

Lateral spines: Spines at the caudal end of the lateral keel.

Lateral setae: Setae of the proximal segment of the labial palpi.

M: Media.

M₁, M₂: Branches of media.

Mandible: The lateral upper jaws of a biting insect.

Media: The fourth longitudinal vein in the wing.

Median cleft of labium: A notch or cleft in the mentum of the labium.

Median lobe of labium: Same as mentum.

Median space: Same as basilar space of the wings.

Mental setae: Setae on the inner surface of the mentum.

Mentum: The central sclerite of the labium, second from the head.

Mesad: Towards the meson.

Mesepimera: Epimera of the mesothorax.

Mesepisterna: Episterna of the mesothorax.

Mesocoxae: Coxae of the mesothorax.

Meson: An imaginary vertical longitudinal plane passed through center of the body of an insect.

Mesopleural suture: Suture separating episternum and epimerum of the pleura.

Mesosternum: Sternum of the mesothorax.

Mesostigmal plates: Small sclerites surrounding the mesothoracic spiracle; in this article, the term refers to the caudal plate alone.

Mesothorax: The middle division of the thorax, bearing the second pair of legs.

Metacoxae: The coxae of the middle pair of legs.

Metallic: Shining; opposed to dull.

Metapleural suture: Suture separating episternum and epimerum of the metathorax.

Metathoracic spiracle: Spiracle of the metathorax.

Metathorax: The third or hindmost segment of the thorax.

- Metepimera:** Epimera of the metathorax.
- Microthorax:** A minute division at the cephalic end of the thorax.
- Nodus:** A slight indentation in the front margin of the Odonate wing, supported by a heavy cross-vein.
- Notum:** The dorsal or upper part of a segment, usually applied to the thorax.
- Occipital foramen:** The opening through which the vital organs pass from the thorax to the head.
- Occipital horn:** Chitinous horns just below the occipital ridge on each side of the head.
- Occipital ridge:** A ridge extending between the compound eyes on the caudo-dorsal angle of the head.
- Occipital spine:** Spine on the caudo-dorsal surface of the head between the compound eyes.
- Occiput:** Region of the head between the compound eyes and behind the transverse suture in Anisoptera.
- Ocellar ridge:** A ridge just behind the ocelli.
- Ocellar stripe:** A pale stripe on the dorsum of the head behind the ocelli.
- Ocellus, -i:** Simple eyes, of which there are three on the dorsum of the head of adult Odonata.
- Ochraceous:** Yellow with a slight tinge of brown.
- Ovate:** Egg-shaped.
- Ovipositor:** The tubular or valve-like structure by which the eggs are placed.
- Palpus, -i:** Jointed appendages attached to labium.
- Paraptera:** Small plates at the bases of the front wings.
- Pile:** Very fine hair-like setae; velvety in appearance.
- Pilose:** With pile.
- Pleura:** The lateral sclerites between the dorsum and sternum of a segment.
- Pollinose:** Covered with a pollen-like dust.
- Postclypeus:** In Odonata the proximal division of the clypeus.
- Postcoxal areas:** Areas on the venter of the thorax behind the metacoxae.
- Posterior:** Hind or hindmost; opposed to anterior.
- Postgenae:** Sclerites on the rear of the head on either side of the occipital foramen.
- Postnodal cross-veins:** Cross-veins between C and R and between nodus and stigma.
- Postocular spots:** Pale spots on the dorsum of the head in Zygoptera behind and usually laterad of the ocelli.
- Precoxal:** Before or in front of the coxae.
- Preocellar band:** A dark pigment stripe immediately in front of the ocelli.
- Prescutum:** Front division of the scutum.
- Proepimerum:** Caudal plate in the pleura of the prothorax.
- Proepisternum:** Cephalic plates in the pleura of the prothorax.
- Pronotum:** Dorsal shield of the prothorax.
- Propleura:** Pleura of the prothorax.
- Prothorax:** That division of the thorax bearing the first pair of legs.
- Proximal:** Extending towards the body.
- Proximal:** Situated near the body; opposite of distal.
- Pruinose:** Hoary; as if covered with a fine frost or dust.
- Pterostigma:** A dark opaque spot on the front margin of the wing near its tip; same as stigma.
- Punctae:** Small spots on the dorsum of Aeshna nymphs.

Quadrangle: A cell in the wing of Zygoptera bounded by M_4 , Cu , Arculus, and a cross-vein between M_4 and Cu_1 (similar in position to the triangle in Anisoptera).

R: Radius.

R_1 : First branch of radius.

Radial sector: A branch of radius which crosses media; supposed to combine several branches of radius.

Radius: The third longitudinal vein of the wings.

Rugose: Wrinkled: with irregular, waved, elevated lines.

R_s : Radial sector.

Sc: subcosta.

Sclerite: A body plate.

Serrate: Saw-toothed; the teeth set toward one end.

Seta, -ae: A pointed movable bristle or stiff hair.

Setiform: Resembling a seta.

Setigerous: Bearing setae.

Setose: Bearing setae.

Sigmoid: S-shaped.

Spatulate: Rounded and broad at top or end, attenuate at base.

Spine: A heavy immovable bristle.

Spinigerous: Provided with spines.

Spinule: A small spine.

Spinulose: Provided with small spines.

Spiracle: A breathing pore or external opening of the air tube or trachea.

Spurious: False or accidental.

Sternites: Sclerites of the sternum.

Sternum, -a: Ventral plates of a body segment.

Stigma: Same as pterostigma.

Striated: Marked with parallel, fine impressed lines.

Stylus, -i: A small rod-shaped projection at the tips of the lateral gonapophysis of the ovipositor; in the male nymph, short acute processes on ventral surface of segment 9.

Sub: A prefix frequently meaning almost; used in such words as subcircular; subtriangular.

Subcosta: The second longitudinal vein of the wing.

Subcostal cross-vein: A single cross-vein between subcosta and radius next the body or proximad of all other antenodal cross-veins; present in *Progomphus* (Pl. x, Fig. 1).

Submentum: The segment of the labium next the head.

Subtriangle: The cell in the wing behind the triangle.

Sulcate: Grooved or furrowed.

Superiors: Dorsal anal appendages.

Supertriangle: The wing cell just in front of the triangle.

Supplementary radius and media: Extra longitudinal veins in the wings between M_3 and M_4 , and M_4 and Cu_1 .

Supraepisternum: Same as anepisternum.

Suture: A depressed line between two sclerites.

Tarsus, -i: The last two or three short segments of the leg of an insect, forming the foot.

Teneral: Individuals not having their full coloration.

Terete: Cylindric or nearly so.

Tergite: Applied to tergum when occupied by a single sclerite.

Tergum, -a: Dorsal surface of any body segment; refers mainly to abdominal segments here.

Tibia, -ae: The fifth segment of the leg or second long segment in dragonflies, bearing the tarsus at the distal end and attached to the femur at the proximal end.

Tibial setae: Setae on the tibiae.

Triangle: A triangular cell in the wing base formed by cubitus and two converging cross-veins between M_4 and Cu_1 .

Trochanters: The second and third segments of the leg in dragonflies; usually short and closely united.

Trochantins: Small sclerites at the base of an appendage.

Truncate: Cut off squarely at tip.

Venter: The lower surface of the whole body or of a division of the body.

Ventro-meson: Intersection of the meson with the ventral surface.

Vertex: An indefinite area on the dorsum of the head, next the front and between the compound eyes.

Vitta: A longitudinal colored line or stripe.

Vulvar lamina: Reduced gonapophyses of the female usually consisting of two small plates, one on each side of the vaginal opening.

Vulvar spine: Spine on venter of abdomen immediately in front of the ovipositor or vulvar lamina.

Wing-cases: Envelopes enclosing the wings in the nymphs of dragonflies.

ACKNOWLEDGMENTS

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PLATE I

Tracheal gills of *Zygoptera* nymphs

There are normally 3 gills attached to the abdomen but for convenience only one or two are shown in most of the figures.

1. *Lestes unguiculatus*
2. *Lestes vigilax*
3. *Lestes congener*
4. *Lestes eurinus*
5. *Lestes disjunctus*
6. *Lestes uncatus*
7. *Enallagma geminatum*
8. *Enallagma ebrium*
9. *Enallagma hageni*
10. *Enallagma calverti*
11. *Enallagma durum*
12. *Enallagma doubledayi*

All greatly enlarged. Fig. 8 by B. H. Walden.

PLATE I

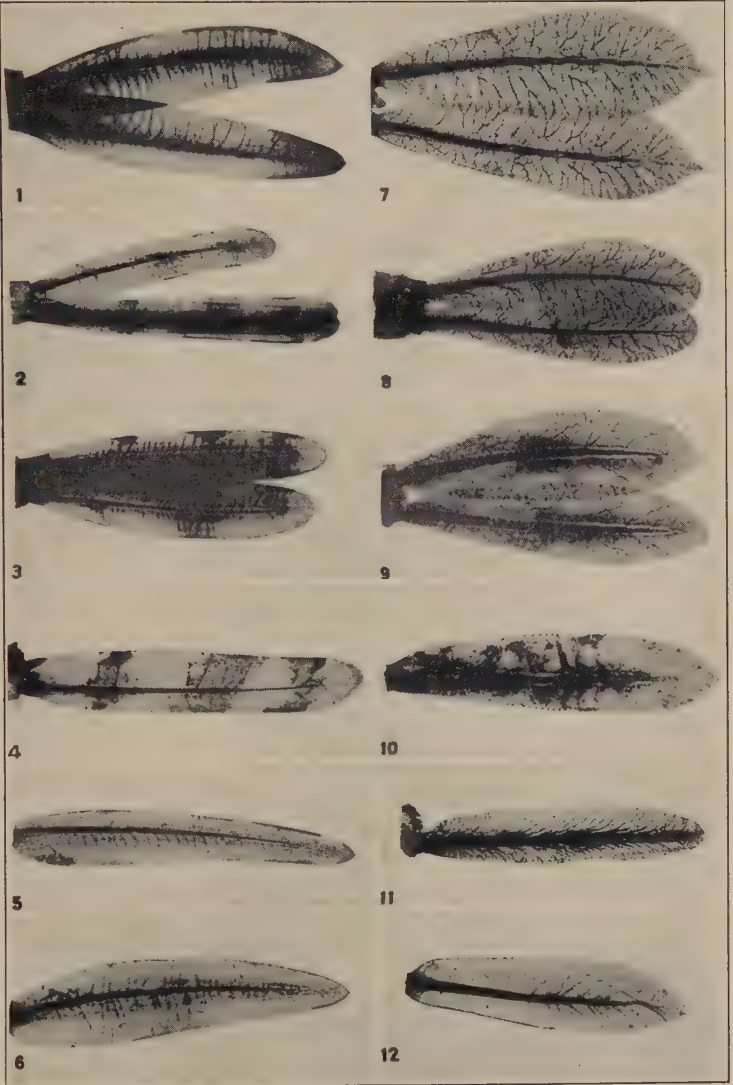


PLATE II

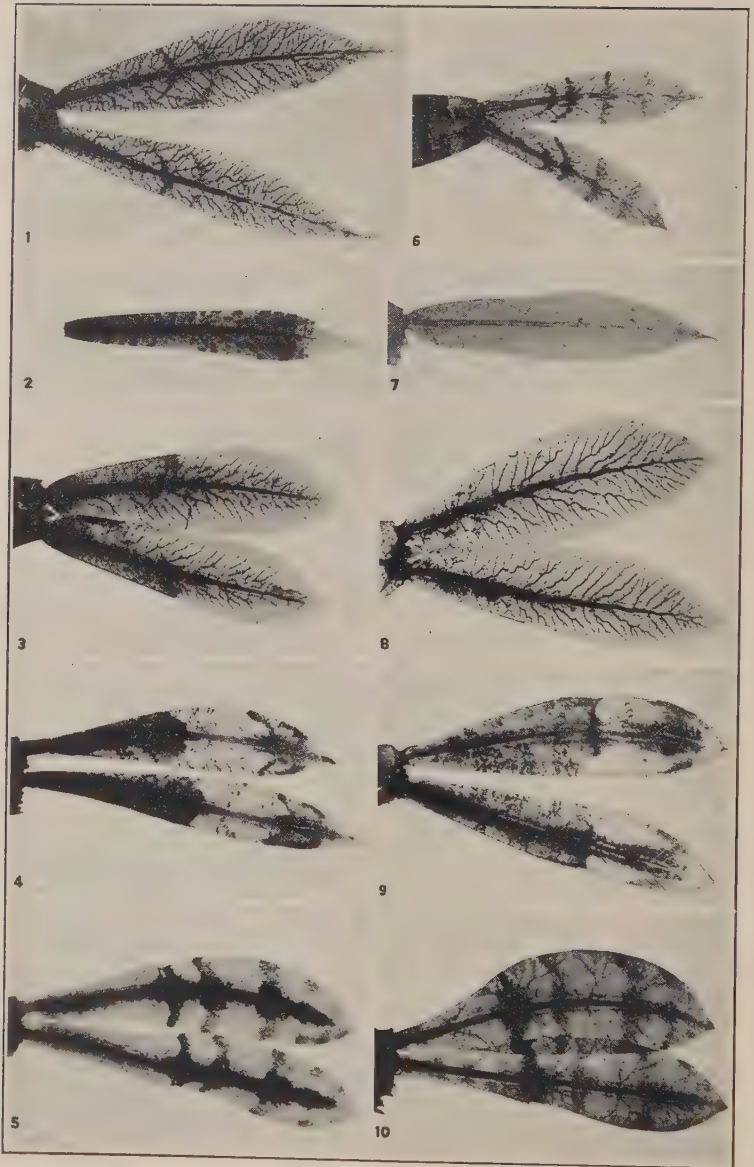


PLATE II

Tracheal gills of *Zygoptera*

1. *Ischnura verticalis*
2. *Chromagrion conditum*
3. *Enallagma carunculatum*
4. *Enallagma traviatum*
5. *Enallagma signatum*
6. *Ischnura posita*
7. *Anomalagrion hastatum*
8. *Enallagma civile*
9. *Enallagma exsulans*
10. *Enallagma vesperum*

All greatly enlarged.

PLATE III

Nymphs and exuviae of *Anisoptera*

1. *Aeshna umbrosa*
2. *Nasiaeschna pentacantha*
3. *Basiaeschna janata*
4. *Boyeria vinosa*
5. *Anax junius*
6. *Dromogomphus spinosus*
7. *Gomphus exilis*
8. *Hagenius brevistylus*
9. *Lanthus albistylus*

Nos. 5 and 8 natural size; 3, 4 and 9 twice enlarged; others slightly enlarged.

PLATE III

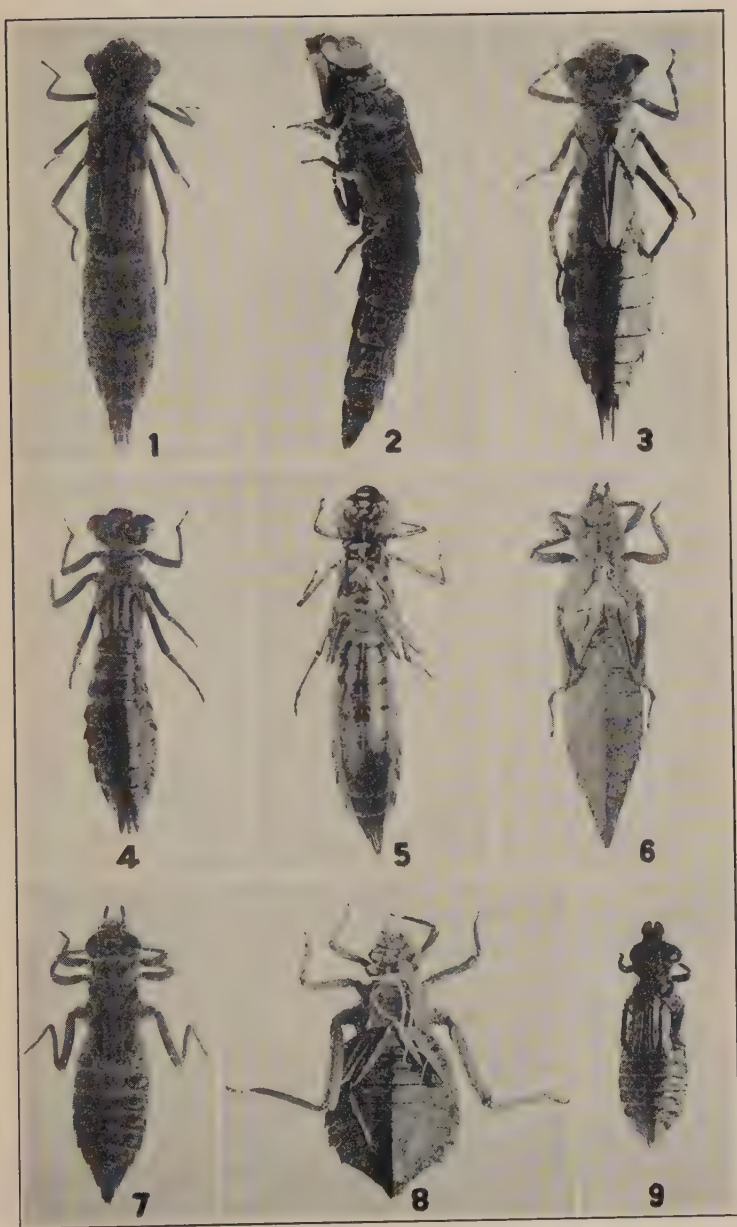


PLATE IV

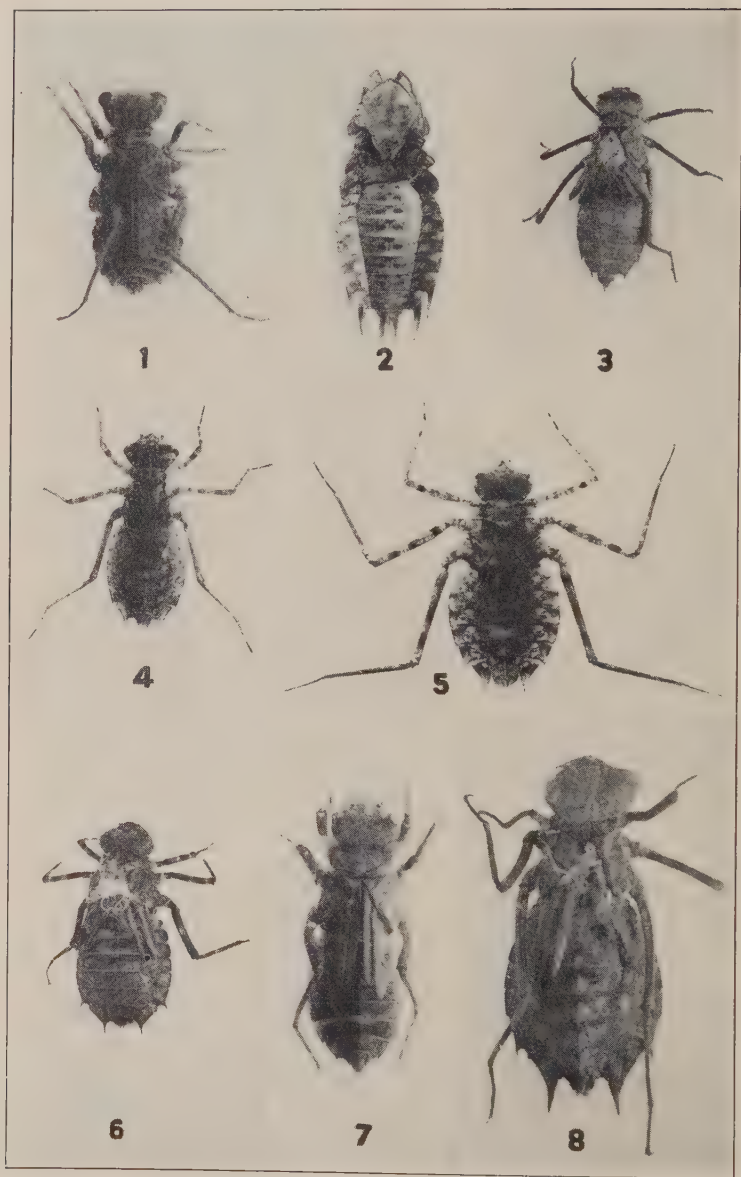


PLATE IV

Nymphs and exuviae of *Anisoptera*

1. *Erythemis simplicicollis*
2. *Tramea lacerata*
3. *Perithemis domitia*
4. *Tetragoneuria cynosura*
5. *Didymops transversa*
6. *Neurocordulia obsoleta*
7. *Plathemis lydia*
8. *Epicordulia princeps*

All somewhat enlarged.

PLATE V

Labia of nymphs

1. *Gomphus graslinellus*
2. *Gomphus fraternus*
3. *Gomphus plagiatus*
4. *Ophiogomphus mainensis*
5. *Lanthus albistylus*
6. *Gomphus pallidus*
7. *Progomphus obscurus*
8. *Gomphus villosipes*
9. *Dromogomphus spinosus*
10. *Gomphus brevis*
11. *Ophiogomphus colubrinus*
12. *Gomphus notatus*
13. *Gomphus vastus*
14. *Gomphus spiniceps*
15. *Gomphus spicatus*
16. *Gomphus lividus*
17. *Gomphus amnicola*
18. *Gomphus scudderi*
19. *Hagenius brevistylus*

All greatly enlarged.

PLATE V



PLATE VI

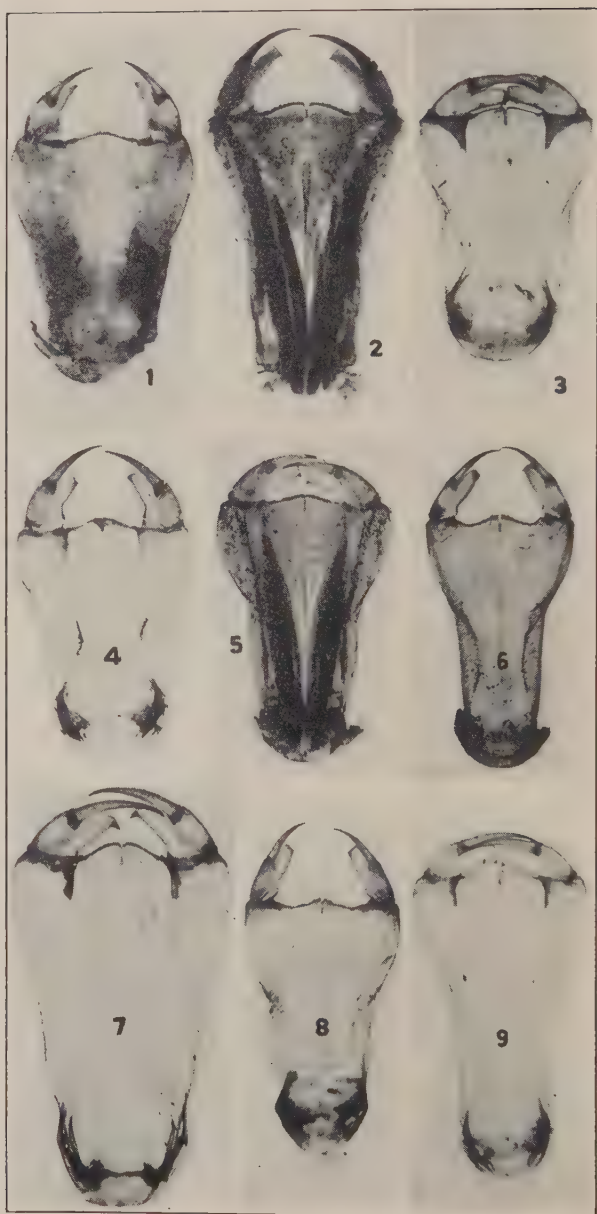


PLATE VI

Labia of nymphs

1. *Basiaeschna janata*
2. *Epiaeschna heros*
3. *Aeshna eremita*
4. *Aeshna canadensis*
5. *Aeshna umbrosa*
6. *Boyeria grafiana*
7. *Anax junius*
8. *Boyeria vinosa*
9. *Aeshna tuberculifera*

All greatly enlarged.

PLATE VII

Labia of nymphs

1. *Libellula pulchella*
2. *Erythrodiplax berenice*
3. *Tetragoneuria cynosura*
4. *Sympetrum vicinum*
5. *Libellula exusta*
6. *Leucorrhinia intacta*

All greatly enlarged.

PLATE VII

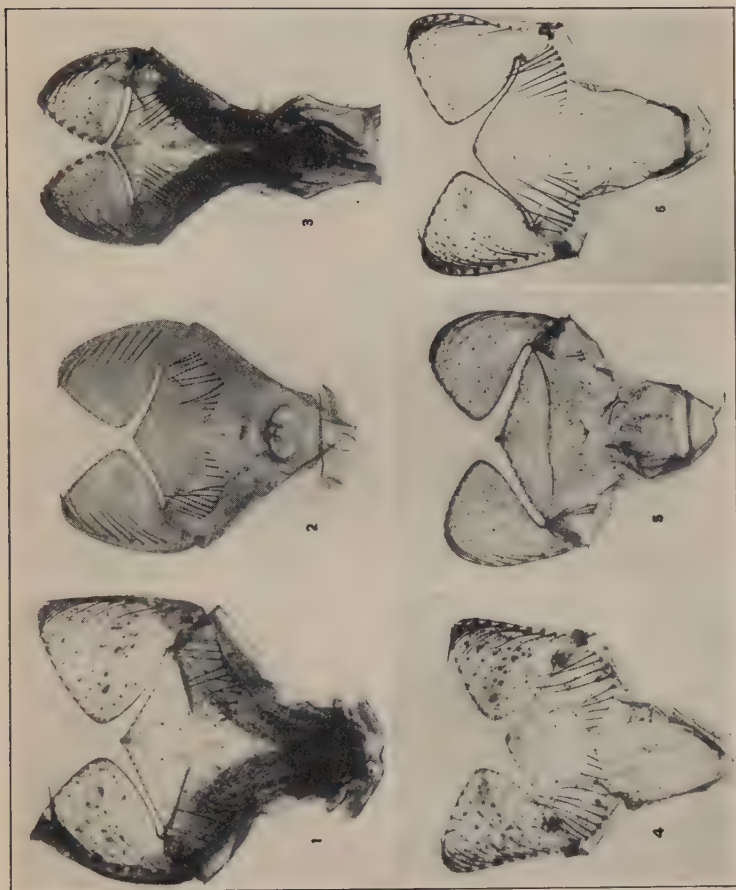


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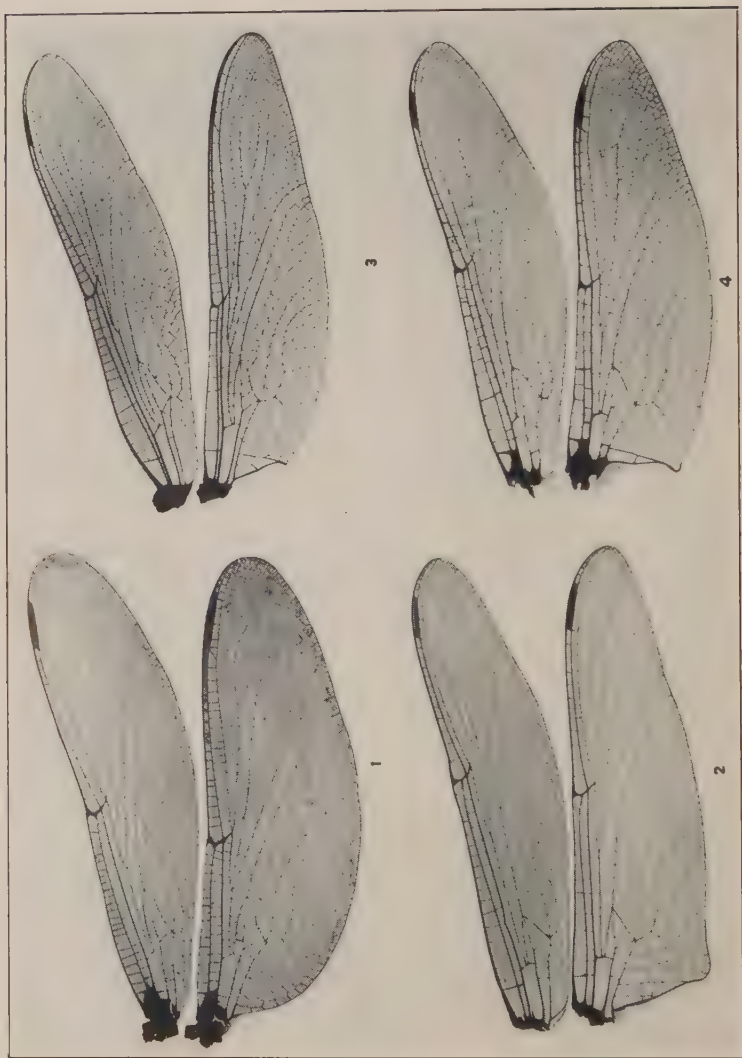


PLATE VIII

Wings of *Anisoptera*

1. *Boyeria vinosa*
2. *Cordulegaster maculatus*
3. *Nasiaeschna pentacantha*
4. *Basiaeschna janata*

No. 4 about twice natural size; others slightly enlarged.

PLATE IX

Wings of *Anisoptera*

1. *Aeshna* sp.
2. *Anax junius*
3. *Gomphus* sp.
4. *Hagenius brevistylus* (male)

No. 3 about twice natural size; others slightly enlarged.

PLATE IX



PLATE X

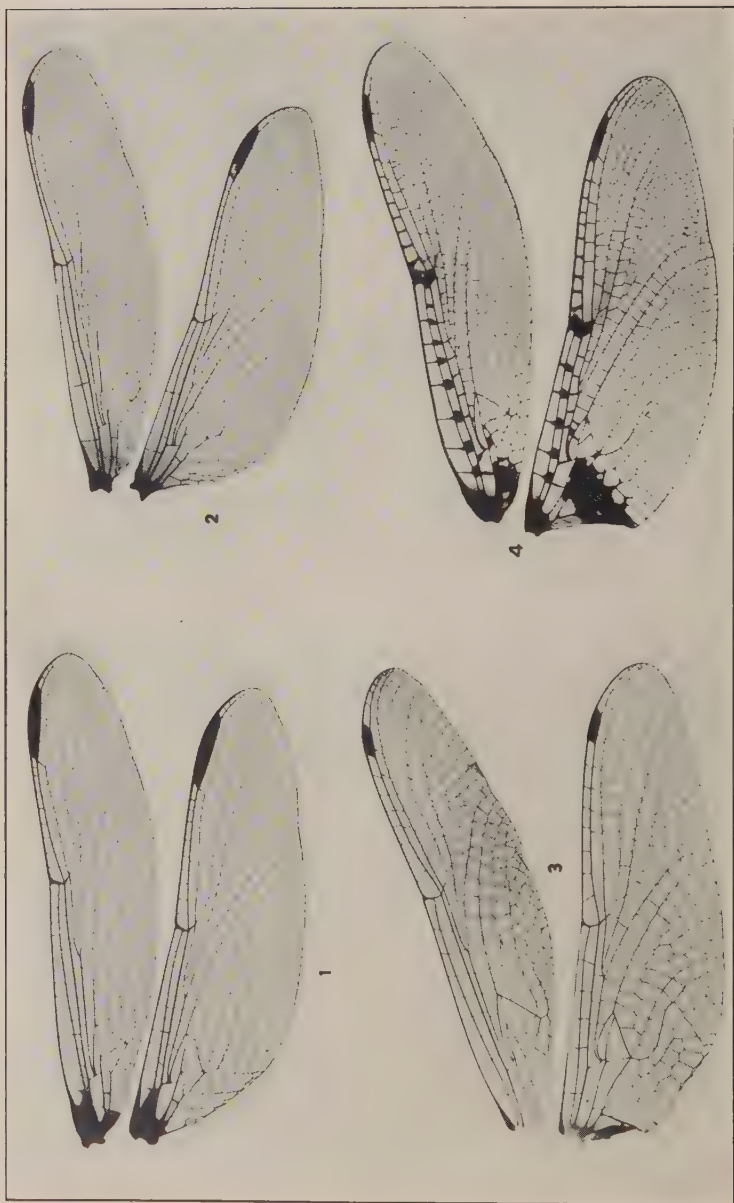


PLATE X

Wings of *Anisoptera*

1. *Progomphus obscurus*
2. *Ophiogomphus rupinsulensis*
3. *Dorocordulia libera*
4. *Neurocordulia obsoleta*

About twice natural size.

PLATE XI

Wings of *Anisoptera*1. *Macromia illinoiensis*2. *Cordulia shurtleffi*

No. 1, twice; No. 2 three times enlarged. Black marks appearing at base of No. 2 are not part of the wings proper.

PLATE XI

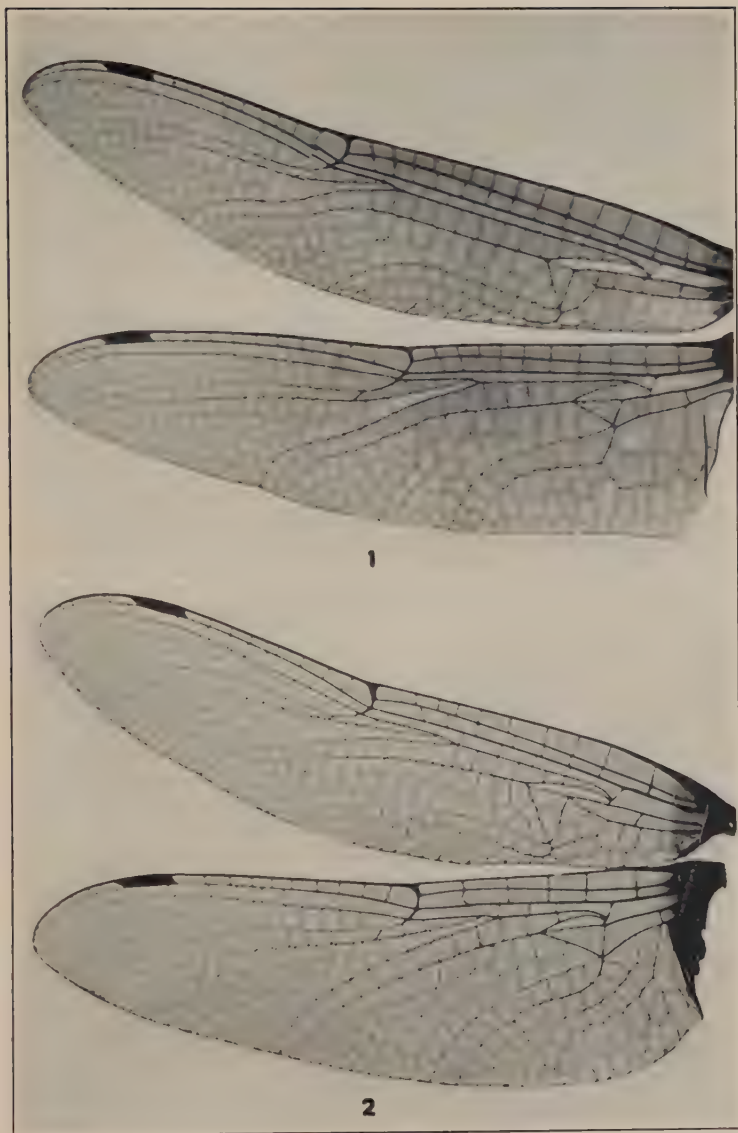


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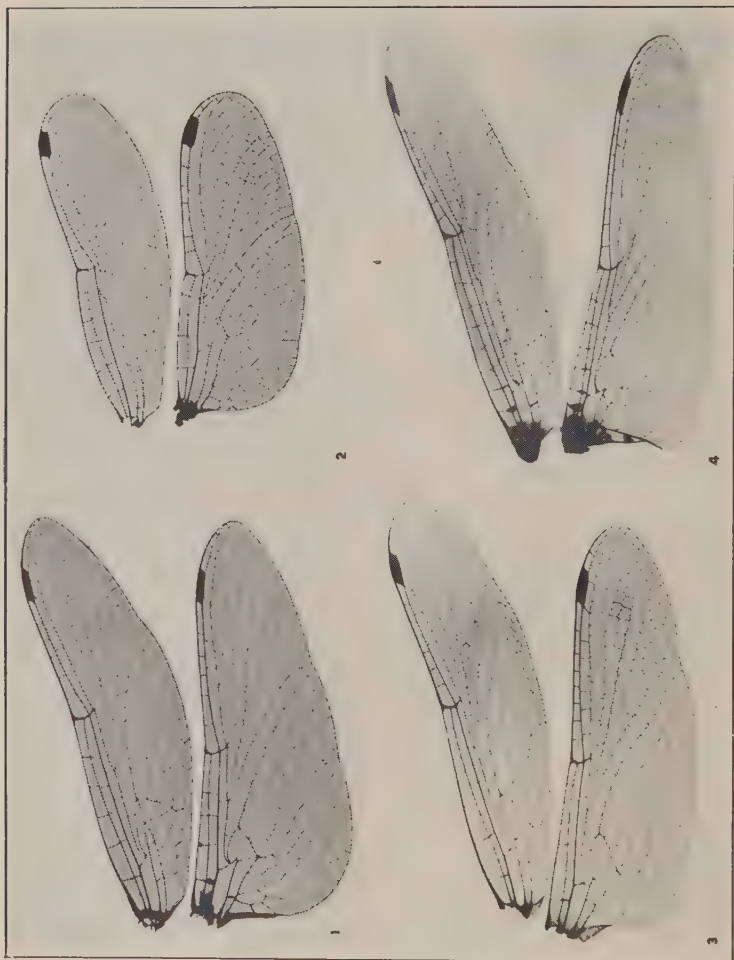


PLATE XII

Wings of *Anisoptera*

1. *Tetragoneuria cynosura*
2. *Nannothemis bella*
3. *Gomphaeschna furcillata*, female
4. *Helocordulia uhleri*

All about twice enlarged.

PLATE XIII

Wings of *Anisoptera*

1. *Celithemis eponina*
3. *Erythrodiplax berenice*
- 2, 4. *Perithemis domitia*, female and male

No. 1 twice natural size; others two and one-half times enlarged.

PLATE XIII



PLATE XIV

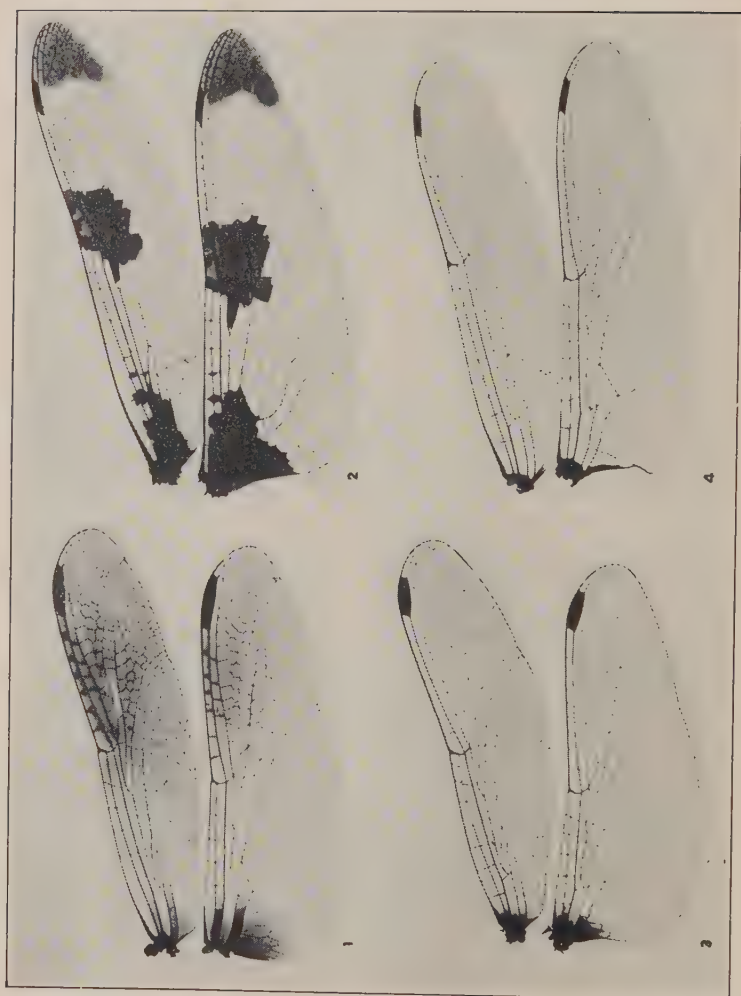


PLATE XIV

Wings of *Anisoptera*

1. *Pachydiplax longipennis*
2. *Epicordulia princeps*
3. *Sympetrum rubicundulum*
4. *Somatochlora linearis*

Nos. 1 and 3 twice enlarged; 2 and 4 slightly enlarged.

PLATE XV

Wings of *Anisoptera*

1. *Pantala flavescens*
2. *Tramea abdominalis*
3. *Libellula cyanea*
4. *Leucorrhinia intacta*

No. 4 about twice natural size; others slightly enlarged.

PLATE XV

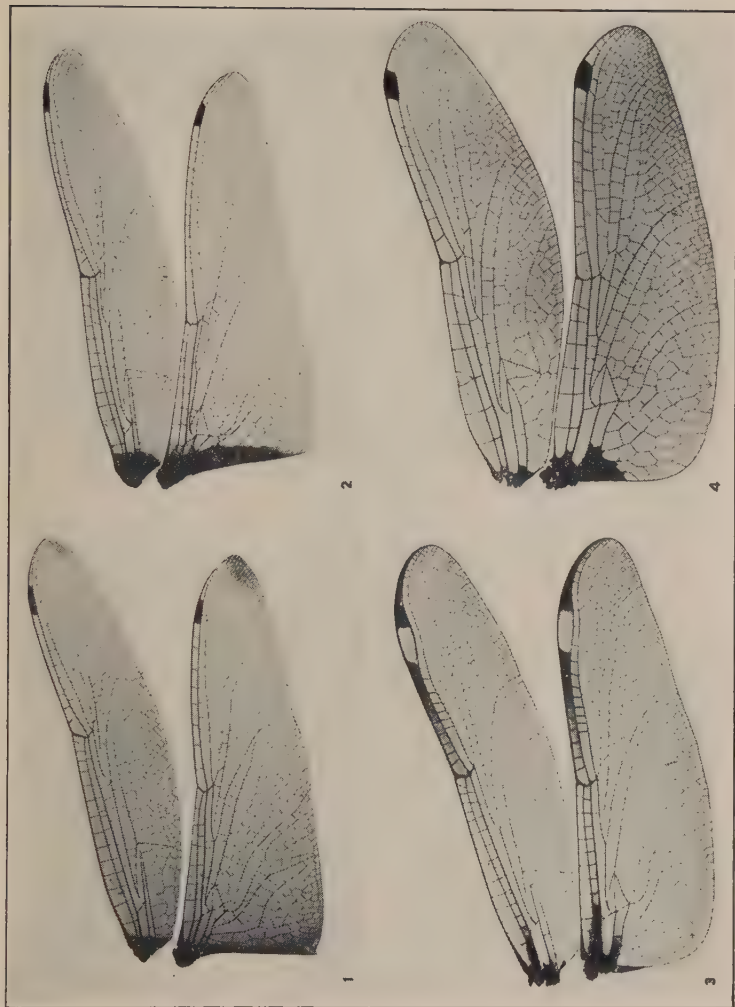


PLATE XVI

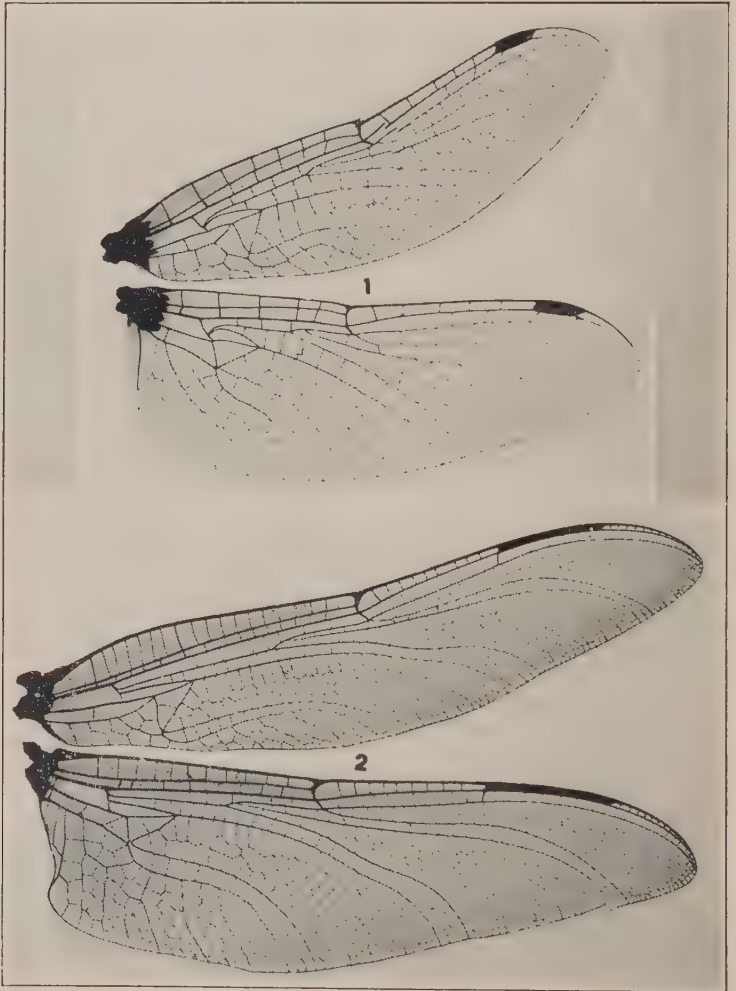


PLATE XVI

Wings of *Anisoptera*

1. *Williamsonia lintneri*

2. *Tachopteryx thoreyi*

About twice enlarged.

PLATE XVII

Adults of *Agrionidae*

- a. *Agrion maculatum*
- b. *Hetaerina americana*
- c. *Enallagma civile*

a and b slightly reduced; c natural size.

PLATE XVII



a



b



c

PLATE XVIII



a



b

PLATE XVIII

Adults of *Aeschnidae*

- a. *Nasiaeschna pentacantha*
- b. *Aeshna umbrosa*

Slightly reduced.

PLATE XIX

Adults of *Gomphidae* and *Cordulinae*

a. *Gomphus spicatus*

b. *Tetragoneuria cynosura*

Enlarged one and one-half times.

PLATE XIX



a

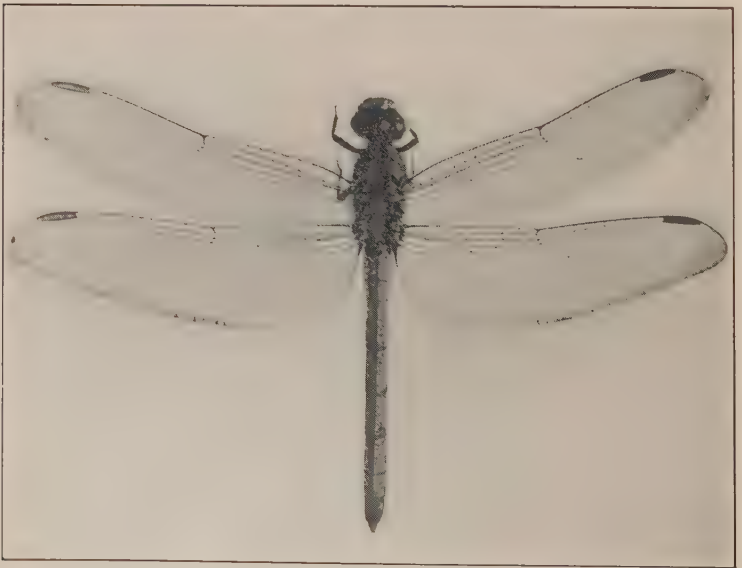


b

PLATE XX



a



b

PLATE XX

Adults of *Libellulidae*

- a. *Libellula exusta* var. *julia*
- b. *Erythemis simplicicollis*

Slightly enlarged.

PLATE XXI

Libellula and *Plathemis* adults

1. *Plathemis lydia*, male
2. *Libellula vibrans*, var. *incesta*
3. *Libellula luctuosa*
4. *Libellula quadrimaculata*
5. *Libellula auripennis*
6. *Libellula cyanea*
7. *Libellula pulchella*
8. *Libellula vibrans*, var. *vibrans*
9. *Libellula semifasciata*

About one-half natural size.

PLATE XXI



PLATE XXII



a



b

PLATE XXII

- a. *Sympetrum semicinctum*
- b. *Celithemis elisa*

Nearly twice natural size.

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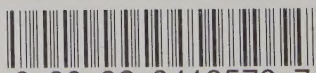
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pt. 5

